(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL

FEBRUARY, 1905.

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ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL.

CANADIAN PACIFIC RAILWAY.

III.

GENERAL CHARACTER OF THE BUILDINGS.

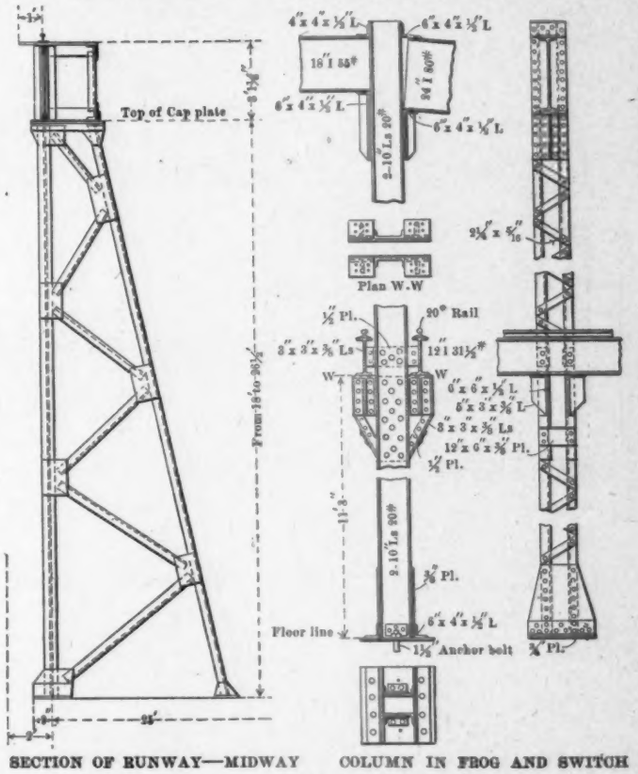
(*For previous article see January, 1905, page 1.*)

Sections of the remaining buildings, except the power house, are presented in the accompanying engravings, also detail drawings of some of the interesting features of the smaller buildings, including a typical wooden roof truss of the car machine shop, a section of one of the Midway crane supports, a column in the frog and switch shop, one in the hardwood storage building and a column showing the connections of the 20-in. I beams supporting the roof of the pattern storage building.

BLACKSMITH SHOP.—As already stated, this is an exceedingly large shop and is most admirably adapted to its purpose. It is built in two portions at right angles to each other; a cross section through the long portion, which is parallel to the midway, is illustrated. The floor is divided into one main bay 43 ft. 4 ins. wide, a side bay at the left 42 ft. 4 ins. wide, one at the right 43 ft. 2 ins. and a narrow bay of 15 ft. at the right for furnaces. In this section the lavatories are also placed. The roof is of 3-in. plank, except that of the furnace bay, which is of expanded metal in concrete. The lighting of this building is excellent. The main portion of the roof has a clear height of 32 ft., with swinging lantern lights over the roof and side bays. The total width of this building, outside of the walls, is 146 ft. 4 ins., as shown in the section, and the other, or shorter portion, is 130 ft. 8 ins. wide. As this building and its equipment are of special interest, it will be made the subject of a separate article later.

CABINET SHOP.—As already stated, this is the only building which is evidently too small; it is 62 x 580 ft., and provides at the eastern end for hardwood storage, with the upholstery department in the second story. The cabinet shop is divided from the other portion of the building by a brick fire wall. This building has two rows of columns and a 15-ft. longitudinal monitor from end to end. The windows are 8½ x 12 ft., with 3 ft. space between them. Those in the upper story are 10 ft. high. The cross section of this building shows the portion having two stories and gives the size of the columns and the principal timbers. It also shows the thickness of the walls and illustrates the construction of the floor. This building has a track throughout its length for handling material. The east end of the building is used for hardwood storage below and upholstery above. Its floor plan will be presented later in connection with the car shops. One of the small details illustrates the column and girder construction in the hardwood storage building, the columns of the lower story of which are of steel.

PASSENGER CAR SHOPS.—The photographic view shows the

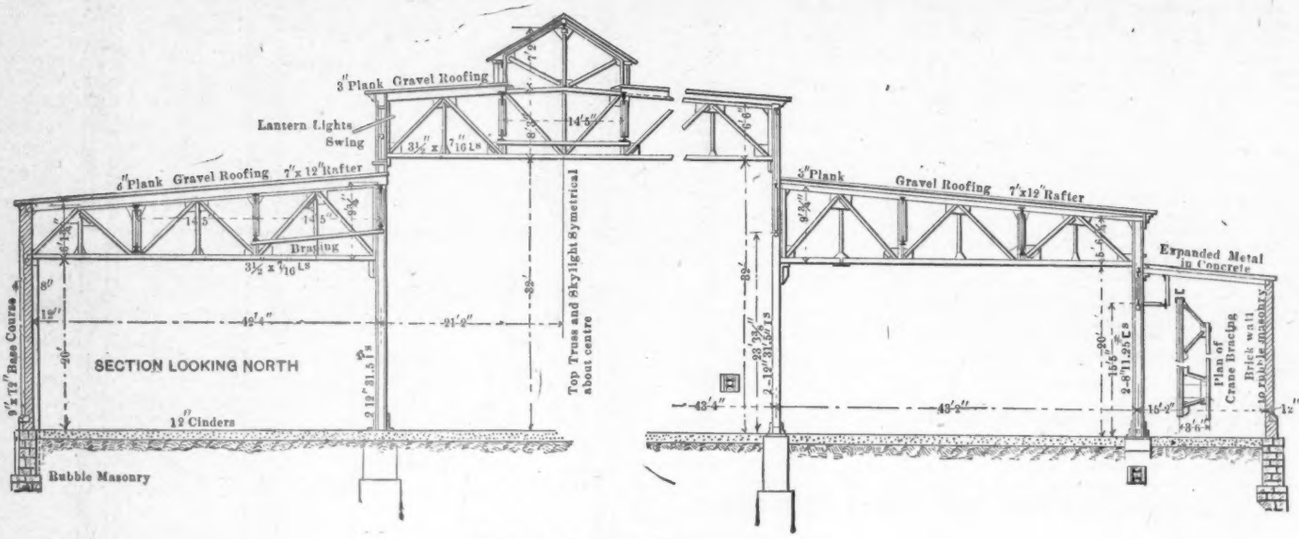


SECTION OF RUNWAY—MIDWAY CRANE. COLUMN IN FROG AND SWITCH SHOP.

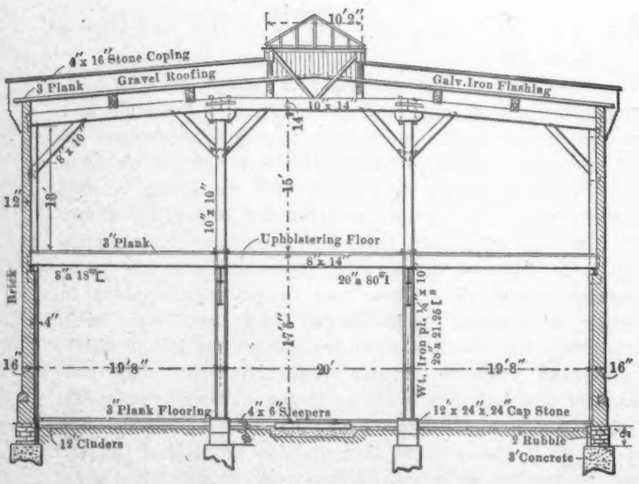
transfer table between the passenger car shops, looking east, with coaches standing outside of the building at the right and trucks and wheels at the left. This photograph presents an idea of the roofs of these buildings and their length, which is 672 ft. The cross section shows the brick walls and wooden posts and roofs. The section selected for engraving shows a brick fire wall, of which there are 3 in the erecting shop shown at the right of the transfer table, and 4 in the paint shop shown at the left. These will be referred to again in presenting the plans of the buildings. They are 12 ins. thick. Each building has 27 12 x 49-ft. transverse skylights, which, with the high windows, furnish admirable light. The construction of the skylights is shown in the sectional engraving. The skylights are arranged over the spaces between the coaches, both in the erecting shop and the paint shop, instead of over the coaches, as is usually done; this arrangement gives better light.

PLANING MILL.—This building is 126 x 500 ft. It has a central line of steel columns and has 2 standard gauge tracks passing through it from end to end, while a single transverse track crosses the building near the west end and ex-

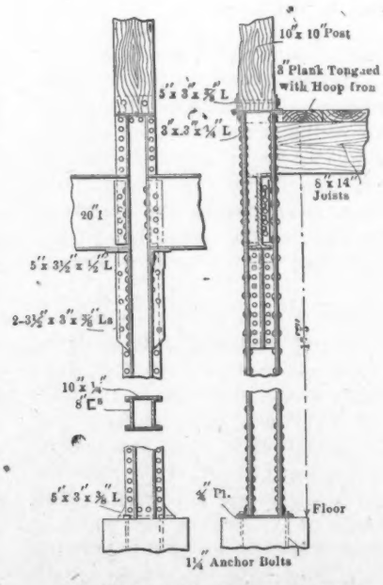
INTERIOR VIEW OF BLACKSMITH SHOP.



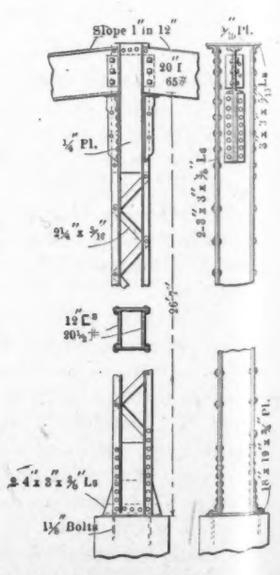
SECTION THROUGH BLACKSMITH SHOP.



SECTION THROUGH CABINET SHOP.


10" x 10" Post
3" Plank Tongued with Hoop Iron
5" x 3" x 5/8" L
3" x 3" x 1/4" L
5" x 14" Joists
20" I
5" x 3½" x ½" L
2-3½" x 3" x 5/8" Ls
10" x ¼"
6" C
5" x 3" x 3/8" L
¼" Pl.
Floor
1¼" Anchor Bolts

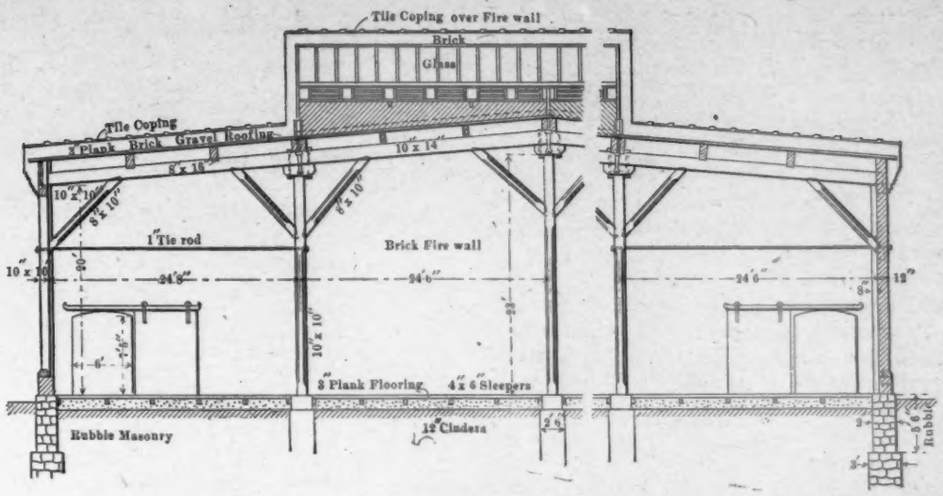
COLUMN AND GIRDER CONNECTIONS IN HARDWOOD STORAGE BUILDING.



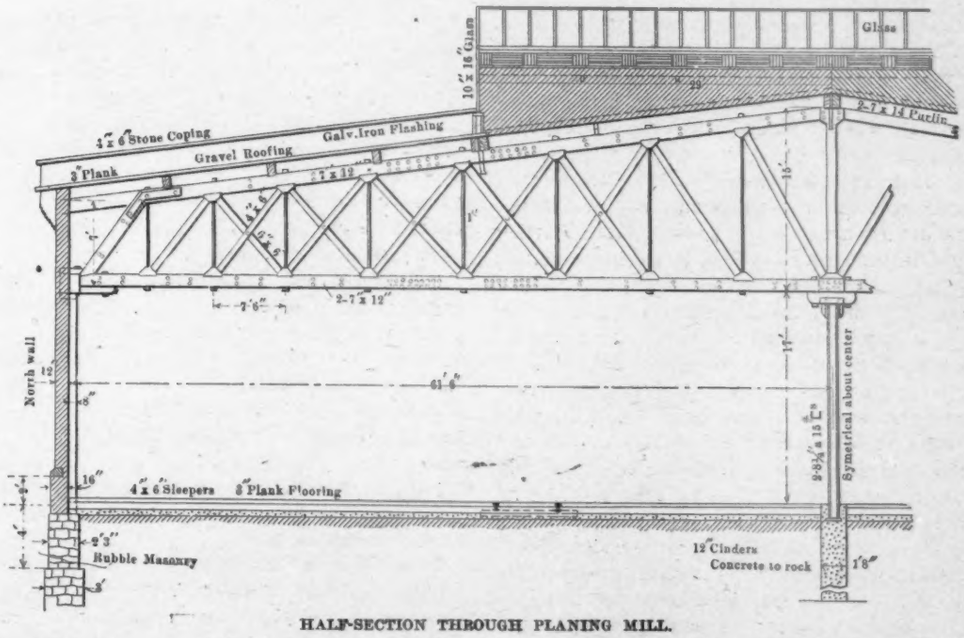
COLUMN IN PATTERN STORAGE BUILDING.

ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL.—CANADIAN PACIFIC RAILWAY.

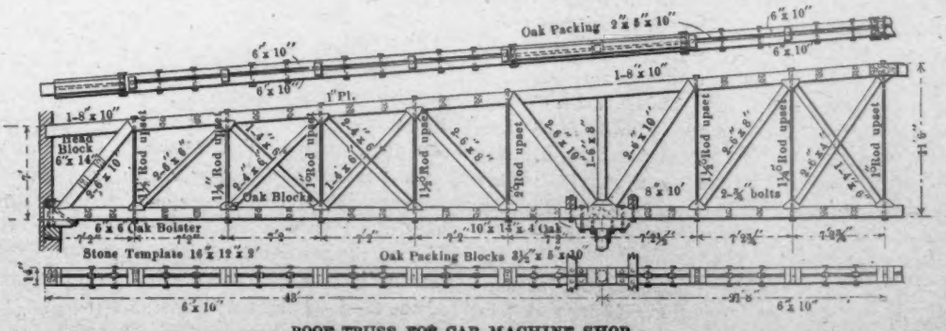
TRANSFER TABLE BETWEEN PASSENGER CAR SHOPS.



SECTION THROUGH PASSENGER CAR SHOP.



HALF-SECTION THROUGH PLANING MILL.



ROOF TRUSS FOR CAR MACHINE SHOP.

ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL.—CANADIAN PACIFIC RAILWAY.

tends to the dry kiln. The roof trusses are of wood. This building is also very light. One of the detail engravings illustrates the roof trusses of the car machine shop, which is typical of the wooden roof trusses with the larger spans. A half cross section of the planing mill is shown with a skylight, of which there are 23, 10 ft. 4 ins. x 29 ft. in size, arranged transversely. These have glazed ends and the windows of this building are made as high as the height of the side walls will permit.

DRAINAGE.—Two brick oval trunk sewers, 2 x 3 ft., lead to the city sewer south of the property. A large concrete covered ditch, 8 x 4 ft., leads the whole length of the property just west of the freight car shop and extends under the locomotive shop, discharging into a natural water course. The ground is generally level, with a slight ridge along the south side of the property. Surface drainage was therefore very important. Cedar boxes are provided, open at the bottom, surrounded by broken stone, and averaging 12 ins. square, being placed from 1 to 4 ft. down. The plot is covered with about 6 ins. of gravel, drained by these box drains, of which about 22,000 linear ft. are provided. Surface drainage from the boxes to the east enters the sewers through cedar manholes adjacent to the regular manholes, provided to settle the dirt. From the well the water flows into main concrete ditches.

HEATING SYSTEM.—The entire heating equipment was furnished by the B. F. Sturtevant Company of Hyde Park, Mass. The maximum distance to which steam is carried is almost exactly a half-mile from the power station. The extent of the heating contract is shown by the combined cubical contents of the buildings, which amounts to 28,400,000 cu. ft. In general terms the skylights occupy about 25 per cent. of the roof area and the windows one-half of the wall area. The heaters require a little over 37 miles of 1-in. pipe, furnished in sections of from 200 to 1,000 ft., in vertical coils, with cast iron bases, connected with fans, which will completely circulate all the air in any building 3 times every hour. The guarantee of the contractors require various temperatures from 60 to 70 deg. when the outside temperature is 10 deg. below zero. In the coldest weather no outside air will be handled by the fans. Separate exhaust and live steam mains are carried to every heater and live steam may be used in all of the heater coils. Returns from each building drain to small vacuum pumps and are carried through a general return main to the power house. Further remarks about the heating system will be made in connection with the subsequent descriptions.

FIRE PROTECTION.—The fire mains are entirely separate from the water service. A 12-in pipe connects to the city mains for fire protection only. This pipe has a pressure of 145 lbs. from a special high pressure city fire service. A 500,000-gal. reservoir, near the power house, is used as a reserve, and the main is fitted with a check valve retaining this supply in case of a failure of the city mains. Two 1,500-gal. underwriters' fire pumps pump from the reservoir if the city supply fails. As an additional precaution, two wells will furnish 20,000 gallons per hour if water is not to be had from the city service. Every building has sprinklers and over 13,000 of them are required in the plant, every 100 sq. ft. of roof area being served by an automatic sprinkler, which is always connected and ready with 145 lbs. pressure. All shops, except special buildings like the dry kilns, blacksmith shop, and others where the normal temperature is high, will open their sprinklers at 155 deg. The mill service consists of a 6-in. pipe leading from the low pressure city mains, connected with a 75,000-gal. tank, the bottom of which is 50 ft. from the ground. This is filled from the wells, or from the city mains; a check valve protects this supply in case of a failure of the main supply. This plant is an example of unusual precautions against fire, the plans having been made with special reference to the experience of fire insurance experts.

TELEPHONE SYSTEM.—The shops are equipped with a complete system of 50 local telephones, including a 75-drop switchboard in the office building, this being quite necessary in a plant of this size. The system has metallic circuit, self-restoring drops and motor generators for ringing.

REPORT OF COMMITTEE ON POWER.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

(DEPRECIATION VALUE OF LOCOMOTIVES.)

(*For previous article see page* 8.)

To find the value of a locomotive at any age from one to twenty years, subtract from the original cost, or from the value determined in price per pound, the value when scrapped. Multiply this by the percentage in third column in Table No. 1 and add the scrap value.

EXAMPLE.—Eight-wheel light locomotive and tender, 15 years old.	
Weight of engine in working order	85,000 lbs.
Approximate value	$8,500.00
Scrap value at ¾c. = $637.00, say	640.00
$8,500 — $640 =	2,605.00

This is the assumed value of the engine when 15 years old, provided the boiler has not been renewed. If the boiler has been renewed, the cost of the new boiler and its application, less the scrap value of the old, is to be added to the depreciated value of the engine at the time the boiler is applied. The rate of depreciation per annum to remain constant, the increased life therefore would be due to the value added when the boiler is renewed.

EXAMPLE.—Eight-wheel light locomotive and tender, 15 years old, with boiler renewed.	
Weight of engine in working order	85,000 lbs.
Approximate value	$8,500.00
Scrap value	640.00
Value at 15 years without new boiler	2,605.00
Value at 15 years with new boiler	2,605.00

To which should be added the cost of rebuilding.

In scrapping small switch engines careful consideration should be given to the fact that the mileage is low and the demand upon the boiler small. This will probably have some influence in the limit of life. There will always exist a demand for some small switch engines of this character in certain localities around shops, factories, etc., requiring considerable light switching. In these localities it would not always pay to use large, heavy switchers.

In the valuation of locomotives several apparent inconsistencies may be observed, but as it is based on actual cost wherever practicable, and assumed cost consistent with the valuation at that time, we have considered it desirable to make no alterations in the value as shown by the records.

The general recommendations for scrapping power have been covered, but in determining the exact order in which engines should be scrapped, out of the large number which come within the recommendations of the committee, it is obvious, other things being equal, that the oldest and least efficient of this number should be the first to be scrapped and gotten out of the way. No doubt among the total number of engines recommended for scrapping a number will be found which, by reason of the good condition, can be kept in service for some time longer by running repairs, which at no time would approach, and certainly not exceed, 10 per cent. of the original value.

Owing to the condition of track and bridges and light traffic, a number of small engines will be required for some time and it will no doubt be advisable to run these engines until they require repairs not exceeding 10 per cent. of their original value.

The report includes a large number of charts, showing in colors the total cost and present value of all of the locomotives on the system. These are based upon a limitation of life of 20 years for each locomotive, unless prolonged to 30 years by the application of a new boiler.

In purchasing locomotives in the future, the committee recommends replacing scrapped switch engines with new ones, each of which will equal 2.3 of the old ones in tractive power. One of the proposed "medium" 2—8—0 engines will equal in tractive power 3.4 of the ones scrapped, and in numbers, 13 of the 2—8—0 class will do the work of 44 locomotives of the lighter classes recommended for scrapping. (This throws a strong light on the value of the recommendations of the report.—EDITORS.)

REDISTRIBUTION OF LOCOMOTIVES.

The committee was directed to consider "any possible redistribution of the power to secure the segregation of engines of similar character, in order to reduce the number of parts to be carried in stock and the cost of repairs."

One of the roads of the system has 89 separate motive power classes and 15 distributing points for repair parts. The conditions which have brought about this distribution of power would need to be thoroughly studied in order to make definite suggestions as to redistribution. The officers in charge can gradually bring together some classes of engines which are scattered without apparent good reason. Increased economies under this head may be obtained by active work in standardization of repair parts.

One of the distribution charts shows the conditions at —— —— upon which point 17 separate motive power classes depend for repair parts. We believe it possible to redistribute these engines in such a manner as to retain but five classes at this point, and at the same time provide sufficient diversity of power to suit the different classes of service required. This would mean that repair parts for five classes of engines would be required in stock at ——— in place of parts for 17 classes, as at present.

The report shows that of the locomotives acquired by the various lines of the system during the past five years there were 68 distinctly different classes.

"CHANGES IN DESIGN OF EXISTING POWER THAT WILL INCREASE THE CAPACITY AND USEFULNESS AND PROLONG ITS LIFE."

This committee, after consideration of the various types of engines now on the system, cannot offer suggestions other than in a general way, covering the scope of this question. The engines are generally used to the limit of their capacity in engine tonnage or the capacity of the roadbed on which they are used. We do not know of any measure by which the life of the power could be prolonged other than in certain suggestions and standardization, referred to later.

We find that many light engines and some of the medium-weight engines are provided with tenders of insufficient water

DEPRECIATED VALUE OF LOCOMOTIVES FROM 1 TO 20 YEARS.

TABLE No. 1.

Depreciation due to age, 5 per cent. of original value, less value of scrap at end of twenty years. Limit of age for light locomotives estimated at twenty years.

Years.	% Depreciation.	% Original Value, Less worth of Scrap.	EXAMPLE.—Original value, $8,500; Scrap Worth $640. Depreciated Value—scrap.	Depreciated Value—scrap.	Amount of Depreciation Each Year.
1	5	95	$7,467	$8,107	$393
2	5	90	7,074	7,714	393
3	5	85	6,681	7,321	393
4	5	80	6,288	6,928	393
5	5	75	5,895	6,535	393
6	5	70	5,502	6,142	393
7	5	65	5,109	5,749	393
8	5	60	4,716	5,356	393
9	5	55	4,328	4,963	393
10	5	50	3,930	4,570	393
11	5	45	3,537	4,177	393
12	5	40	3,144	3,784	393
13	5	35	2,751	3,391	393
14	5	30	2,358	2,998	393
15	5	25	1,965	2,605	393
16	5	20	1,572	2,212	393
17	5	15	1,179	1,819	393
18	5	10	786	1,426	393
19	5	5	393	1,013	393
20	5	0	0	640	393

COST OF REPAIRS ALLOWED ON LOCOMOTIVES WHEN 20 AND 25 YEARS OF AGE AND OVER.

TABLE No. 2.

Class.	Repairs When Over 20 Years. Cost.	Repairs When Over 25 Years. Cost.	Aver. Cost of Class.	Repairs Allowed. 20 Years Old.	Repairs Allowed. 25 Years Old.
15-in. eight-wheel....	....	5 %	$7,000	....	$350
16-in. eight-wheel....	....	5 %	8,000	....	400
17-in. eight-wheel....	10 %	5 %	9,000	$900	450
16-in. ten-wheel.....	....	5 %	8,500	....	425
17-in. ten-wheel.....	....	10 %	9,200	....	920
18-in. ten-wheel.....	....	10 %	10,000	....	1,000
15-in. 4-wh. switch...	10 %	5 %	6,000	600	300
16-in. 4-wh. switch...	10 %	5 %	6,500	650	325
15-in. 6-wh. switch...	....	5 %	6,500	....	325
16-in. 6-wh. switch...	....	5 %	7,000	....	350
17-in. 6-wh. switch...	....	10 %	7,500	....	750
18-in. 6-wh. switch...	....	10 %	8,000	....	800
17-in. mogul.....	10 %	5 %	8,000	800	400
18-in. mogul.....	10 %	5 %	9,000	900	450

The amount of repairs allowed on old locomotives and the extension of the age limitation in this statement has been increased beyond the limits imposed on the rest of the power by reason of the demands for light power and the present condition of tracks and bridges and of light business generally on branch lines.

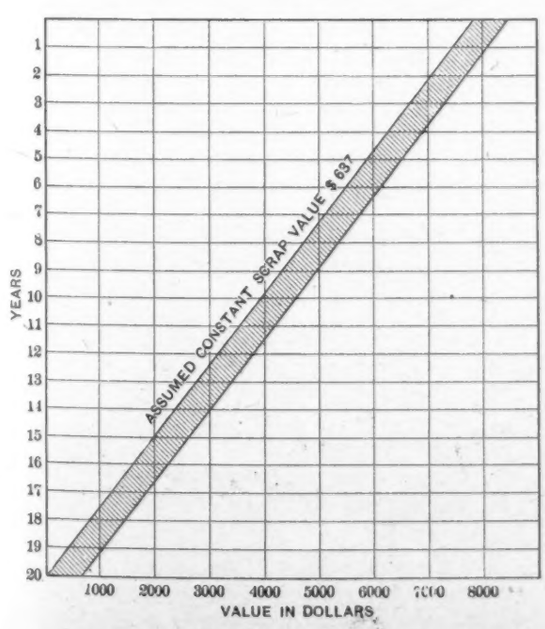


DIAGRAM SHOWING DEPRECIATION OF LOCOMOTIVES FROM 1 TO 20 YEARS. ORIGINAL VALUE, $8,500; SCRAP VALUE, $637.

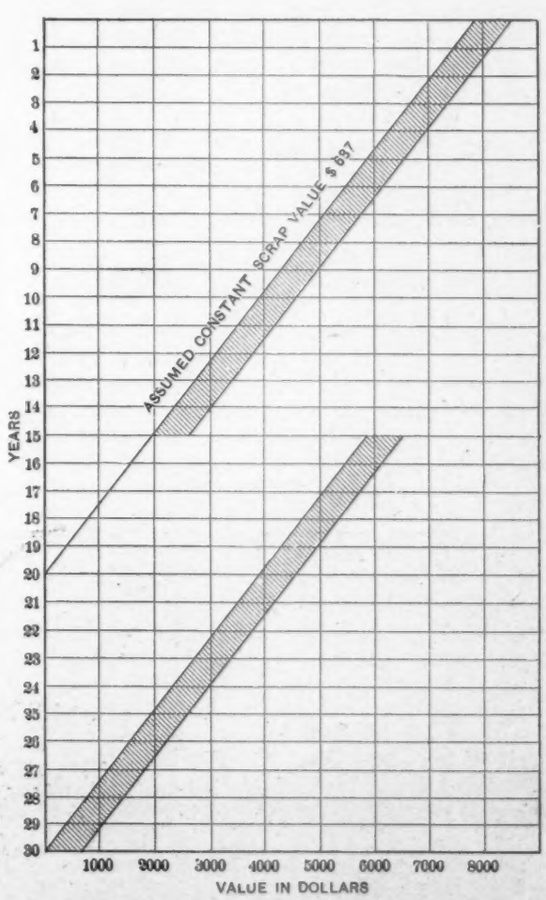


DIAGRAM SHOWING DEPRECIATION OF LOCOMOTIVES FROM 1 TO 30 YEARS. ORIGINAL VALUE, $8,500; SCRAP VALUE, $637. BOILER RENEWED WHEN 15 YEARS OLD.

capacity for good service, and we would recommend the general policy of purchase of larger capacity tanks, which may be considered as standards in the purchase of future equipment. These to be applied where the heavier power is deficient in water capacity; tanks of these engines in turn to be put back on lighter engines, eliminating the light tenders with wooden tender frames, which are too old to maintain. It will be noted in the discussion of new power to be bought that we recommend tenders of three capacities, viz.:—

7,000 gals., tank 24 ft. long, 10 ft. wide.

6,000 gals., tank 24 ft. long, 10 ft. wide.

4,500 gals., tank 19 ft. 6 ins. long, 9 ft. 10 ins. wide (switch engines with sloping tank).

The 24 ft. length of these tanks is considered desirable to obtain the lowest practicable center of gravity and spread of trucks. The 6,000-gal. capacity tender is considered desirable for fast passenger service engines and the medium freight power.

It is evident that the systems must have a considerable proportion of relatively light power for branch line service and divisions having light rail and bridges, where the traffic conditions do not justify the use of heavy power. The proposed elimination of a large number of light engines will necessitate a redistribution of the medium and heavier power, realizing thereby the advantages of modern engines over greater territory. This is possible, as is shown by proposed improvements to track and bridges. There may be some territory where this rule may not apply, but instead of purchasing new light equipment, we would suggest that careful examination of old equipment would probably disclose some engines with sufficiently heavy machinery to warrant the application of new boilers, which, however, cannot greatly exceed the size, weight and steam pressure of the boilers now on the engines. We do not urge or press this procedure, believing that the best ultimate economy will be reached in improving track and bridges, so as to increase the use of the heavier power.

As a further means of increasing the usefulness of existing power, we might state that the further standardization of parts would keep the engines on the road a greater portion of the time, by not waiting the shipment of odd repair parts. Both systems have a large number of classes of engines, many of these by no means old, on which the repair parts differ. While such standardization means a large amount of study and arrangement, yet we believe that it could be done advantageously to some extent. The following items to be considered as engines go through the shops in general repair:

Cylinder heads, pistons, eccentrics and eccentric straps, engine truck wheels and axles, piston rod and valve stem packing, water connection between engine and tender, driving springs, engine truck springs, tender springs, automatic couplers on tenders and pilots, friction and draw castings between engine and tender, tender axles, tender trucks.

To submit a typical case of the value of standardization of repair parts, we would cite the question of locomotive grate bars. As will be seen elsewhere in this report, but one pattern of grate bar is proposed for all the standard parts of locomotives recommended, and this bar is also applicable to some of the late power received. The great variety of widths of fireboxes on the older equipment requires a very large number of patterns, and a heavy stock of grates at stores and roundhouses, which could be greatly reduced had the policy of having as few widths as possible been a standard practice. It is now too late to remedy this very much, and as the old engines are scrapped, these odd patterns will be eliminated.

On the other hand, there are many parts, fittings and trimmings, which may be made common to many, if not all engines, such as cylinder cocks, water gauge cocks, certain parts of the motion work, etc. Reducing these to the smallest number required will greatly reduce storehouse stock, and a considerable expenditure to bring about standardization will soon be repaid.

WATER PURIFICATION.

Purifying water in special plants for softening and settling, which removes a large percentage of the solid matter before it is delivered to the locomotive tender, is one of the most efficient means of increasing the usefulness of the present power. Too much emphasis cannot be placed on this matter. A very large proportion of expense due to boiler repairs, resetting flues, etc., could be avoided with pure water. The increased temperature of flues, and firebox sheets, caused by coating of scale, is very detrimental to the metal. It is the most prolific cause of leaky flues, cracked sheets, etc., which is now met with in locomotive operation. The loss of evaporation of water per pound of coal, due to scale on heating surface, would also be avoided. This is one of the most insidious losses, the magnitude of which is not always appreciated.

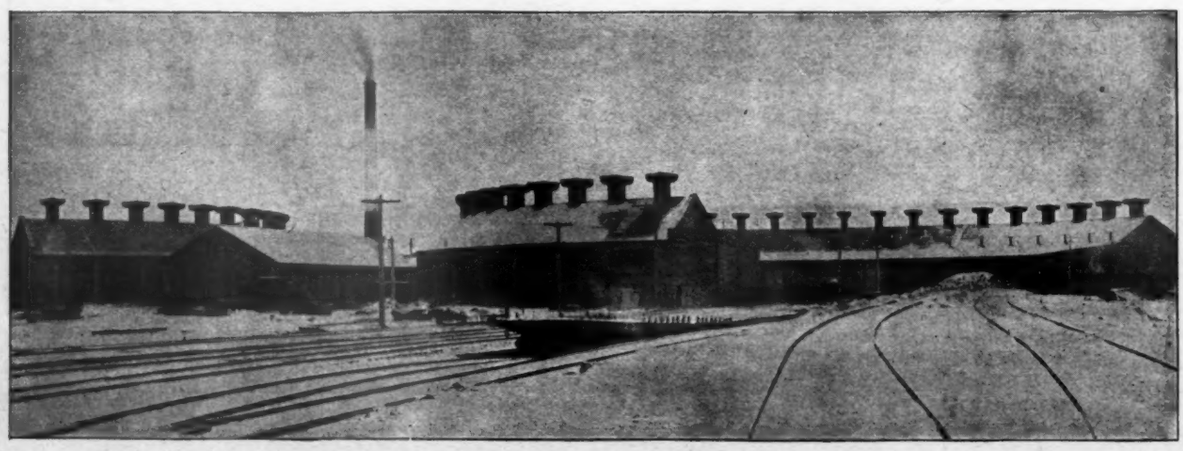
(To be continued.)

NEW ROUNDHOUSES AT ELKHART.

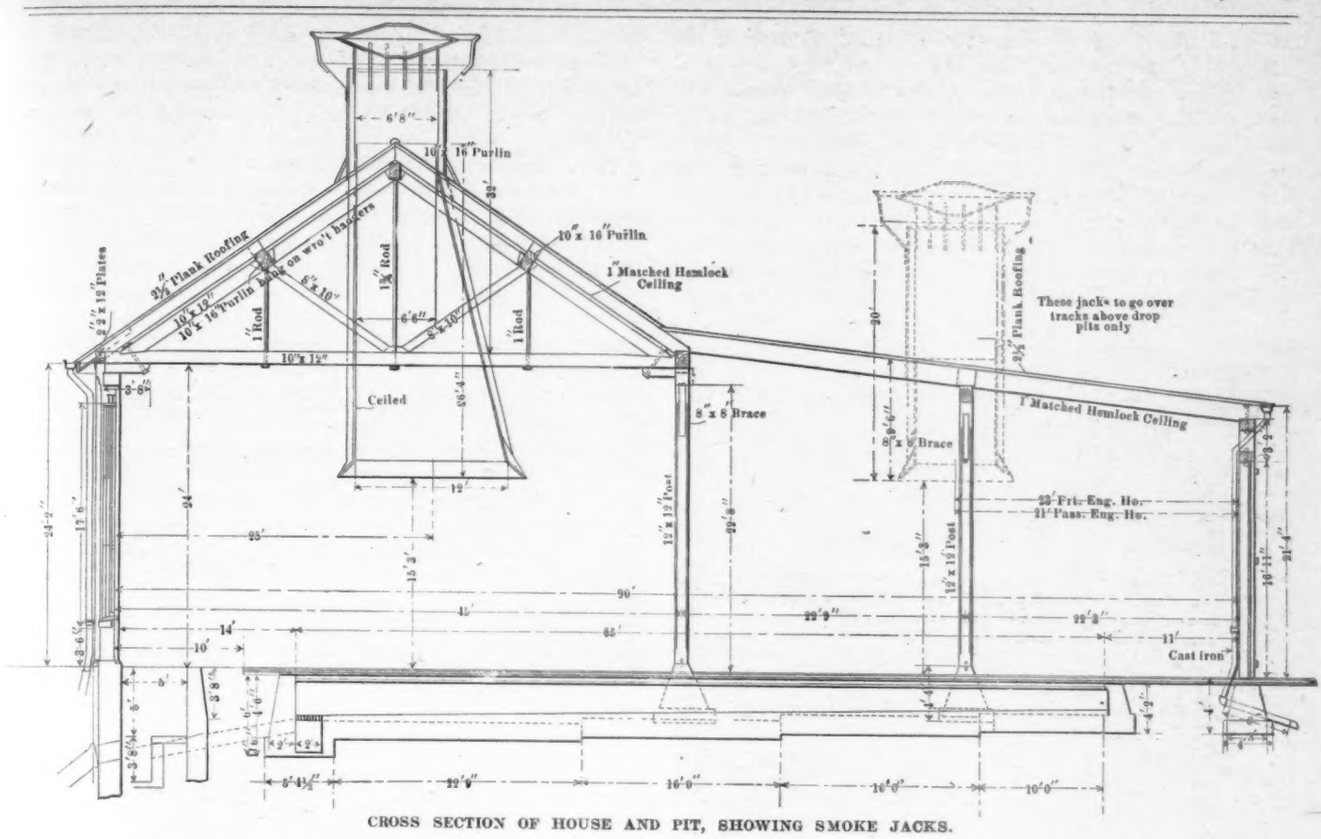
LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

If progressive general managers had witnessed the work which the writer saw last month at this new roundhouse, the construction of this plant would mark a new epoch in locomotive operation.

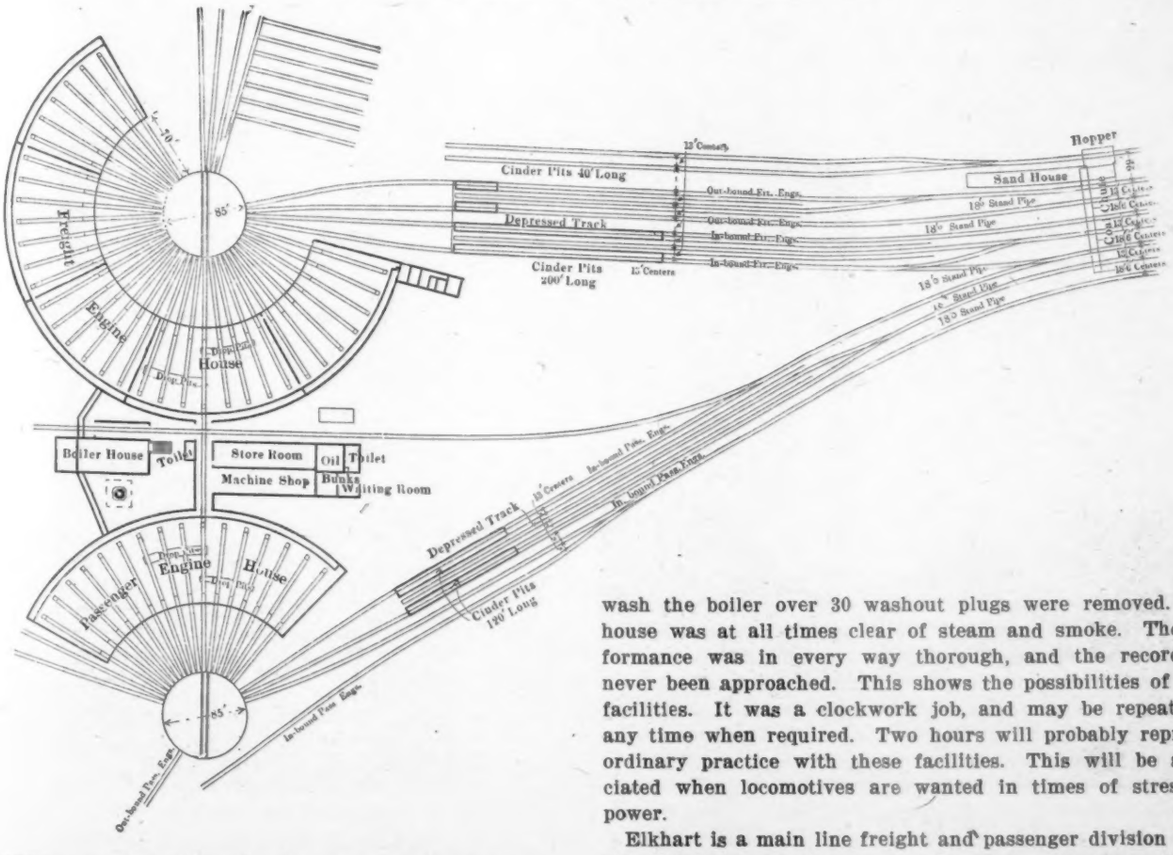
January 16, consolidation Engine No. 711 (see AMERICAN ENGINEER, February, 1900, page 37) was brought to the house and the fire dumped at 9:45 a. m., with 178 lbs. of steam on the boiler. At 9:50 the engine was in the house. At 9:55 blowing-off commenced, steam from the dome and water from the blow-off cocks. At 10:27 the boiler was completely blown down. At 10:38 the washout plugs were out and washing out with hot water began at 10:40. At 11:17 the washing out was completed. The boiler was filled with hot water, the fire started with fagots, steam was taken from the flexible con-



GENERAL VIEW OF HOUSES, LOOKING ACROSS FREIGHT TRACKS.



CROSS SECTION OF HOUSE AND PIT, SHOWING SMOKE JACKS.



GENERAL PLAN OF TRACKS AND HOUSES, LOOKING SOUTH.

nection for the blower, and at 11:38 the engine was on the turntable with 65 lbs. of steam. The total time in the house was 1 hour 48 minutes. During this time 33 flues were caulked, the brick arch was removed and replaced by a new one, the flues were all blown out by air, the front end, and, in fact, the entire engine and tender, thoroughly inspected, the tank was thoroughly cleaned inside, the engine and tender wiped, a new set of piston rod packing was applied, and to wash the boiler over 30 washout plugs were removed. The house was at all times clear of steam and smoke. The performance was in every way thorough, and the record has never been approached. This shows the possibilities of these facilities. It was a clockwork job, and may be repeated at any time when required. Two hours will probably represent ordinary practice with these facilities. This will be appreciated when locomotives are wanted in times of stress for power.

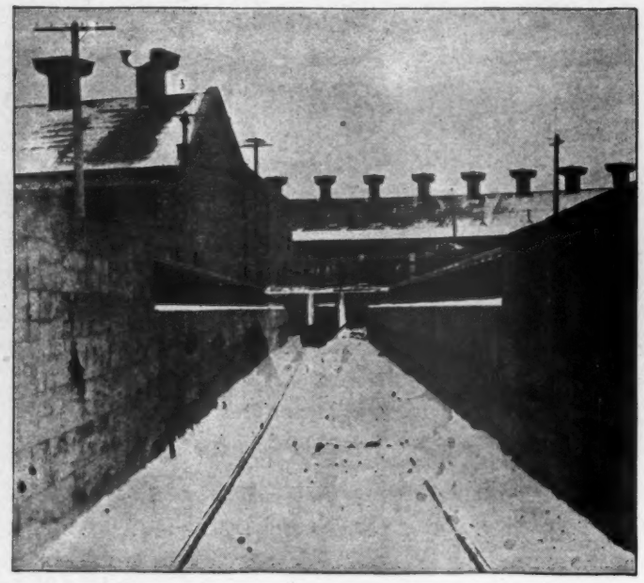
Elkhart is a main line freight and passenger division point, 101 miles east of Chicago. At this point a new "hump" yard for classification of both eastbound and westbound freight has been put into service, the ultimate capacity of which will be about 2,000 cars, classified, in each direction per day. The yards are about 2½ miles long, and they include about 50 miles of tracks. At the present time 161 locomotives, including both passenger and freight, are turned here daily.

The track arrangement was made to suit a triangular piece of ground upon the south side of the main tracks, immediately west of the Elkhart station. The plan is shown as seen from

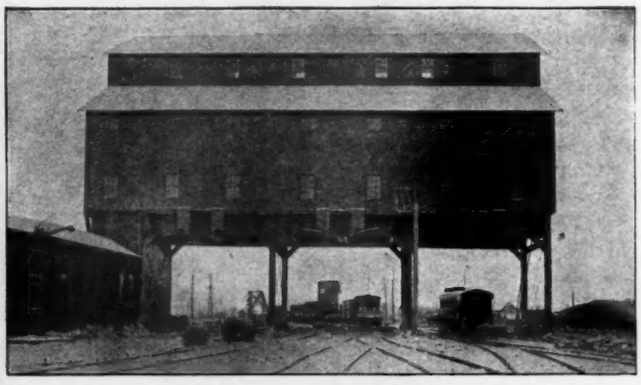
the main tracks looking south, the roundhouses being at the east end of the triangle. The new freight yard is located west of the roundhouse territory, and freight engines will move directly east from the freight yard to the coal chute, which spans all of the tracks over which engines will pass to the roundhouses. They will take coal and sand, and then move a short distance to the standpipes for water, and thence over the cinder pits to the house. Passenger engines will leave their trains east of the roundhouse territory; they will move westward over the track which lies outside of the coal chute, and adjacent thereto, over which they will move to the coal chute switches. They will then move eastward over the cinder pits to the passenger house, which is the house with sixteen pits. This double movement could not be avoided without providing separate coal chutes for the passenger and freight houses. There was not room for two chutes, and this arrangement renders one conveniently available for all locomotives. It is obvious that in case of a breakdown of one of the turntables, one of the houses can be used for all engines.

The question of using separate houses was most carefully considered, and inasmuch as the number of passenger engines is sufficiently large to require an independent force of men, it was considered desirable to provide a special house for them. In doing this, the heavy work on both passenger and freight engines can be carried on in close proximity to the shop facilities.

The arrangement of the shops, power house and other buildings is convenient. A special track is provided for delivery to the oil house, store house, machine shop and power house. This crosses the passageway between the two houses, and the arrangement places the power house in space which would otherwise be valueless.

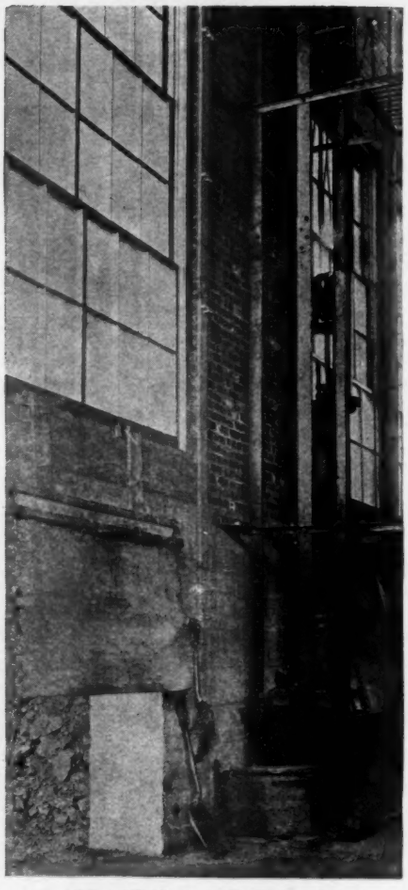


ONE OF THE 200-FT. ASH PITS.



COAL CHUTES.

REAR VIEW OF BOILER HOUSE.



ASH HOIST IN BOILER HOUSE.

The machine shop is 25 ft. wide by 102 ft. long, the storeroom being of approximately the same size; the boiler house is 34 ft. by 72 ft. 6 ins., with an annex 34 ft. by 20 ft. 9 ins., to provide for the heaters of the boiler washing system. A waiting room, 21 ft. 6 ins. by 15 ft. 11 ins. in size, for engineers and firemen is provided. The oil house is 28 ft. by 26 ft. 8 ins. and the toilet room has a space of 13 ft. 9 ins. by 26 ft. 8 ins. An outside toilet room is also provided in a space of 18 ft. by 9 ft. 9 ins. Offices are provided at the freight house.

Special attention should be directed to the drop-pits, of

which four are provided in each of the houses, and located near the machine shop. At such a large terminal, it is desirable to facilitate the heavy work, and this arrangement is used to avoid delays due to locomotives waiting for drop-pits. The drop-pit tracks have two smoke-jacks each, in order that engines may be headed in either direction.

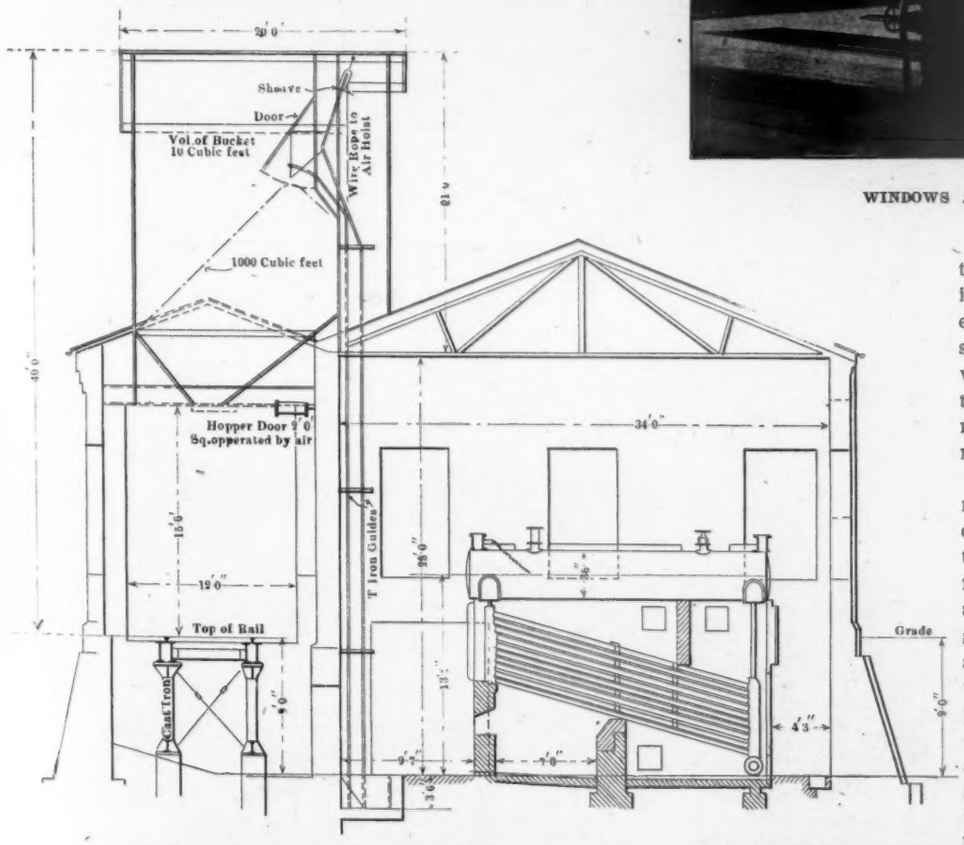
The passenger house has sixteen pits, and the freight house thirty-four. Both houses will be provided with additional tracks, reached by the turntables, for storage outside of the houses. These are indicated in the plan. The radius of each house is 202 ft. 7 ins. to the inside of the outer wall. The inside radius is 111 ft. 7 ins. The outer walls are 12 ins. thick. The houses themselves are of 90-ft. span, and the turntables are 85 ft. long. The angles of the houses are 6 deg. 40 min. The pits are 65 ft. long, with 11 ft. of floor space toward the turntable and 14 ft. outside. There is 24 ft. of head room under the trusses, and 15 ft. 3 ins. under the smoke-jacks. The pits drain toward the turntable. The windows are large and high.

The question of one or two houses was an important one, which received very careful consideration, and is worthy of special attention in a study of this plan. The additional cost for two buildings is not very much larger than for the same facilities provided in a single house, except the cost of the additional turntable and a portion of the cost of the additional cinder pits for the second house. If a single house had been used, an extensive arrangement of cinder pits and coaling appliances would have been required, in order to provide prompt movement when engines come to the terminal in bunches to congest the cinder pit district. In the winter, frequently a lot of freight engines will arrive simultaneously with a number of passenger engines, all of which will need prompt coal and ash pit service. Probably preference would ordinarily be given to the passenger engines, which would delay the freight. With two houses, and separate cinder pits, the work may go farward independently upon both. Switch engines are often brought in in numbers at one time. In the plan described, these may be run over any of the cinder pits which happen to be available, either the long ones or the short ones. The short pits in this case are intended for engines which have stood in the house long enough to require dumping of ash pans. These pits may be used without moving engines off of the long pits. It is interesting to note that the plain shovel pits, with depressed tracks, are used here without hoisting devices. The arguments for and against two houses are summed up as follows:

Advantages—1. Separation of passenger and freight engines to avoid slow movement of either. 2. Avoidance of the danger of tieing up the plant through the failure of one turntable because of ice or breakdown. 3. The heavy work section of each house is brought near the machine shop, concentrating the work.

Disadvantages.—Slight additional cost of two turntables.

WINDOWS AND SMOKE-JACKS.



CROSS SECTION THROUGH BOILER HOUSE, COAL TRACK AND ASH POCKET.

This house has a high roof over the front ends of the engines, giving a large volume of air over the engines, and causes a tendency for steam to rise to the highest point, where it will escape through ventilators around the jacks. As a matter of fact, the houses are remarkably clear of steam and smoke.

The heating system is of the direct steam type, this and the washout system having been supplied by the Erie Heating Company. The foundation work, turntable pits and ash pits are of concrete. The engine house main buildings, as well as the other buildings, are of brick, with wooden roof trusses. The power house roof is of steel, covered with tile, while the other roofs are of wood, covered with gravel and tar. Concrete construction was used for the ash bin in the power house. The floor of the power house is depressed, in order to facilitate the handling of coal without a trestle. The ashes are raised into a pocket holding a full carload, which may be dumped into an empty coal car. Attention will be directed to many important details in another article.

One of the features of these houses is the division by fire walls into sections of eight pits each. This renders it possible to save heating such portions as may not be filled with engines. It is intended to group engines requiring heavy work in the sections nearest the shops.

FREIGHT LOCOMOTIVE WITH WALSCHAERT VALVE MOTION.

LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

Walschaert link motion combines two entirely distinct motions—that derived from a single eccentric and the other from the crosshead—in such a manner (see Auchincloss) that their combined effect is quite analogous to the motion obtained from the stationary link. The eccentric is usually applied in the form of a return crank from the main crank pin, its center being located on a line at right angles to the crank arm. The angular advance becomes zero and the link gives no lead or lap. The link oscillates about a fixed axis, and its radius is the length of the radius rod. In the construction illustrated, the end of the radius bar is connected to the link lifter arm by a slip joint. A union bar, pinned to the combination lever, extends from a short arm, which is rigidly secured to the crosshead. This lever combines the eccentric and crosshead motions, provides the angular advance, and gives the valve constant lap and lead. This motion facilitates the equalization of cut-off, and causes the irregularities of the piston motion to be accompanied by similar effects in the motion of the valve, which prevents the irregularity from deranging the events of the stroke.

American practice has favored the Stephenson motion, with its variable lead, and the Lake Shore & Michigan Southern is understood as turning toward the Walschaert gear for constructive reasons. Large freight engines afford little room for eccentrics between the driving wheels. While there is sufficient space for the parts, they are very inaccessible, and the result is that they are not properly inspected. Walschaert gear strongly recommends itself on the score of accessibility,

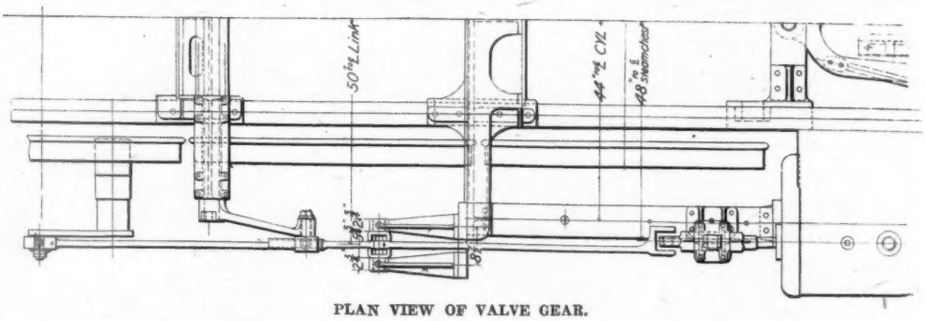
LAKE SHORE LOCOMOTIVE WITH WALSCHAERT VALVE GEAR.—AMERICAN LOCOMOTIVE COMPANY, *Builders.*

VALVE SETTING OF ENGINE 912, WITH WALSCHAERT VALVE MOTION.
(Measurements Furnished by the Railroad Company).

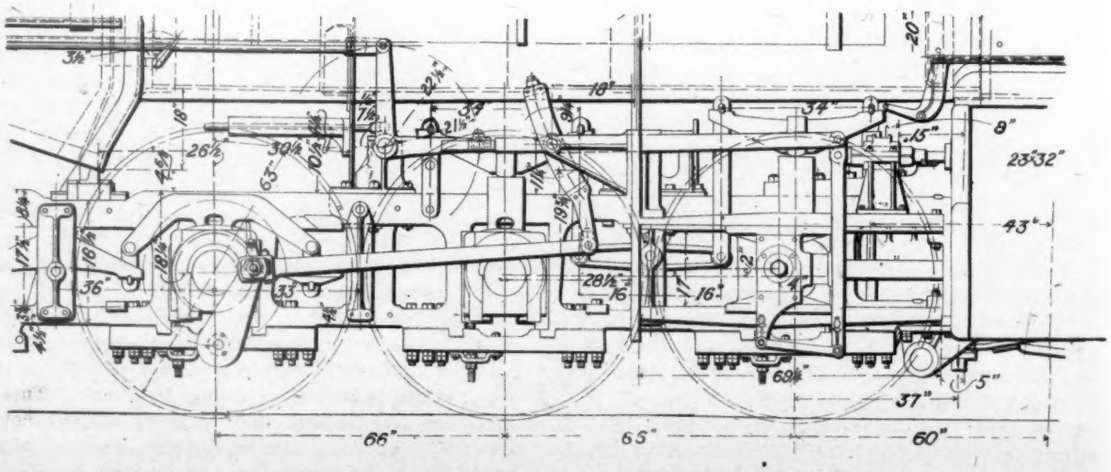
Position. Forward Motion— R. H. Side.	Pre-Admission. Front.	Pre-Admission. Back.	Lead. Front.	Lead. Back.	Port Opening. Front.	Port Opening. Back.	Cut Off. Front.	Cut Off. Back.	Release. Front.	Release. Back.	Closure. Front.	Closure. Back.
Full gear	3-64	3-64	9-64	9-64	2	1 13-16	27⅞	27	30⅝	30½	1½	1 9-32
⅞ stroke	3-32	3-32	9-64	9-64	¾	⅞	21 1-16	20⅝	28¼	28	4	3¼
½ stroke	3-16	3-16	9-64	9-64	17-32	9-16	16 3-32	16⅝	26⅛	26¼	5¾	5⅛
⅛ stroke	¼	¼	9-64	9-64	21-64	11-32	10⅝	11 7-16	24¼	23¾	8¼	7¾
¼ stroke	11-16	11-16	9-64	9-64	7-32	7-32	5 13-16	6 11-16	21	20⅞	11⅛	11

Position. Backward Motion— R. H. Side.	Pre-Admission. Front.	Pre-Admission. Back.	Lead. Front.	Lead. Back.	Port Opening. Front.	Port Opening. Back.	Cut Off. Front.	Cut Off. Back.	Release. Front.	Release. Back.	Closure. Front.	Closure. Back.
Full gear	3-64	3-64	5-32	⅛	1 13-16	1 15-16	27⅞	27	30¾	30 5-16	1 11-16	1¼
½ stroke	3-32	3-32	5-32	⅛	9-16	19-32	17 9-16	17 11-16	27⅝	26 11-16	5 5-16	4⅝
¼ stroke	5-16	5-16	5-32	⅛	5-16	5-16	9⅝	10 3-16	23 13-16	23 9-16	8 7-16	8 3-16

Eccentric crank travel ..... 17 15-16 ins.
Link radius ..... 65 ins.
Steam lead, forward ..... 3-16 ins.
Steam lead, backward ..... 3-16 ins.
Steam port ..... 1⅝ ins.



PLAN VIEW OF VALVE GEAR.



WALSCHAERT VALVE GEAR APPLIED TO A LAKE SHORE LOCOMOTIVE.

and it is not believed that the exposure of the valve gear to accidental derangement when outside, by being struck by obstructions, constitutes a serious disadvantage. This gear has been used in a small way for many years in this country without difficulty, and it now appears to meet a newly developed need. It was originally developed by E. Walschaert, in Belgium, in 1844. It was applied to the Mallet compound of the Baltimore & Ohio last year, as shown on page 237 of the June, '04, number of this journal, and is in common use abroad.

The Lake Shore locomotive is similar to the New York Central 2—8—0 freight locomotives, illustrated in this journal in January, 1904, page 16. This valve gear was selected because of its accessibility, the lightness of the parts, and the fact that it permits the use of two-bar front frames.

Walschaert gear also offers the advantage of direct pull and thrust throughout, and it should be specially advantageous for compound locomotives, where the increase of lead of the Stephenson gear necessitates providing large spaces to compress into. It is noteworthy that the four-cylinder Vauclain compounds (see AMERICAN ENGINEER, June, 1903, page 210) require valve chambers of the same diameter as the high pressure cylinders.

CONSOLIDATION LOCOMOTIVE.—WALSCHAERT VALVE MOTION.

LAKE SHORE & MICHIGAN CENTRAL RAILWAY.

GENERAL DIMENSIONS.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	223,000 lbs.
Weight on drivers	198,000 lbs.
Wheel base, driving	17 ft. 0 ins.
Wheel base, total	25 ft. 11 ins.
Wheel base, total engine and tender	60 ft. 6½ ins.
Tractive power	45,685 lbs.

CYLINDERS.

Diameter	23 ins.
Stroke of piston	32 ins.
Diameter of piston rod	4 ins.
Kind of piston packing	cast iron rings

VALVES.

Kind	Piston
Travel	6 ins.
Steam lap	1 in.
Exhaust lap	0 in.

WHEELS.

Diameter of driving wheels outside of tire	63 ins.
Diameter of driving wheel centers	56 ins.
Material of driving wheel centers	Cast steel
Diameter engine truck wheels	33 ins.
Diameter and length of main driving journals	10 ins. x 12 ins.
Diameter and length of other driving journals	9½ ins. x 12 ins.
Engine truck, kind	Two-wheeled swing
Engine truck journals	6¼ ins. x 10 ins.

BOILER.

Style	Radial stay, straight top
Outside diameter of first ring	81⅝ ins.
Working pressure	200 lbs.
Firebox, length	106 ins.
Firebox, width	76 ins.
Firebox plates, thickness	Sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube sheet, 9-16 ins.
Firebox, water space—side, back and front	4½ ins.
Tubes, number	460
Tubes, diameter	2 ins.
Tubes, length	15 ft. 6 ins.
Tubes, gauge	11, B. W. G.
Heating surface, tubes	3,709.42 sq. ft.
Heating surface, firebox	182.5 sq. ft.
Heating surface, arch tubes	30. sq. ft.
Heating surface, total	3,921.92 sq. ft.
Grate, area	54.9 sq. ft.
Grate, style	Rocking
Exhaust pipes	Single
Smoke stack, top above rail	14 ft. 9¾ ins.

TENDER.

Style	Water bottom
Wheels, diameter	33 ins.
Journals, diameter and length	5½ ins. x 10 ins.
Tender frame	10-in. channel
Water capacity	7,500 gals.
Coal capacity	12 tons

In the matter of weight of parts, the details, in pairs, of the Walschaert gear of this engine are as follows: Crosshead arms, 60 lbs.; vibrating rods, 220 lbs.; eccentric rods, 220 lbs.; links, 260 lbs.; transmission bars, 140 lbs.; valve rods, 70 lbs.; eccentric cranks, 100 lbs.; vibrating links, 70 lbs.; valve stems, 72 lbs., and transmission bar hangers, 72 lbs. This means a total weight of 1,252 lbs. for the entire valve gear of the Lake Shore engine, not including the valves. The weight of the corresponding valve gear parts of a recently constructed 20 x 28-in., 4—6—0 engine, with Stephenson link motion, is 2,734 lbs. Such a weight, which must be moved and reversed for every revolution, imposes severe duty upon the eccentrics, and it is not surprising that they heat.

IMPRESSIONS OF FOREIGN RAILROAD PRACTICE.

EDITORIAL CORRESPONDENCE.

PARIS.

Friends, take the advice of one who knows, and do not attempt to jump on a railroad train at a gladly forgotten station on the edge of France after the train has started. It is only by virtue of being the editor of this journal that I am not now languishing in a dungeon in some old Bastille in this sunny land. I had a ticket, but arrived late and had lots of hand baggage. The train had just started for a 60-mile run without a stop. The door of the coach was closed, but I got it open and fell in. Fell is just the word, because I landed in the arms of the guard, who might himself have been imprisoned for my offense. He was immediately reinforced by a large bunch of French soldiers, with whom the trains are always more or less filled. I was seized by many hands and dragged into the dim light of a compartment and then the jabbering began. Their part was in French and mine in English. I had my ticket and waved it, but ineffectually. It was evident that a commandment had been broken and something was to be done with me. The years of study of French at school were too long ago to accomplish anything against these odds and so volleys of good American were fired with precision and vigor. It did no good whatever, but an inspiration led me to produce a copy of the AMERICAN ENGINEER from the luggage and this won the day. Not knowing what might be in store for me, it seemed necessary to escape the railroad premises very hurriedly in the small hours of the morning when the next station was reached, which fortunately was where I wanted to go. Now it seems very funny, and the joke is too good to keep, but let me seriously advise all travelers to take a copy of the AMERICAN ENGINEER with them. It surely had a wonderful effect on those cheerful Frenchmen. It moved and impressed them; they let the villain go and I lost the opportunity to scratch my initials on cold French prison walls. I ought to have been arrested, and so ought everybody who jumps on to a moving train—unless he "has to."

When in England, riding on a well-known railroad, the train had started and a great commotion occurred in the compartment next to mine. A man had dared to get on when the train was in motion. He had tried to get on once and was foiled by the guard. He tried again and was successful, only to be pulled out of the compartment by the legs. He was then surrounded and taken off to the police station for breaking the law. Next day the papers had a full account of the struggle and notice of the trial. It did not seem to occur to any one that it might be dangerous to pull a man off a moving train after he had safely got on. In traveling in Europe it is well to arrive at your station at least three-quarters of an hour before the train leaves in order to avoid these little difficulties.

These experiences, however, explain why so few passengers are injured on English and Continental railways. Regulations are provided and they must be obeyed, by all—as a rule.

Railroads are taken very seriously in Europe. Nothing there is done to-day and undone to-morrow. Progress is slow, yet there is progress. The equipment is kept up in the best of condition. Signals are everywhere. Travelers are protected against faults of others and faults of their own. No trespassing, whatever, is permitted. Much fault may be found with methods, but no price is too high to be paid for safety. Our own railroads will avoid future Government interference if they will study this lesson in time.

I found several foreign locomotive men surprisingly well informed upon American practice. One of them in England referred to recent American locomotives, stating sizes of cylinders, heating surfaces, weights and other details, indicating a close study of our progress. In Mulhouse I found Mr. de Glehn studying our practice by having his draftsmen reproduce in working drawings various details which appear in American journals, in order to ascertain whether or not ideas obtained from them could be adapted to his practice. Nothing

new appearing in this way is missed, and I found his draftsmen at Mulhouse very thoroughly informed on American locomotives. In fact, they asked me questions which I found difficulty in answering. They "went for" me on the subject of frame construction, and as a result I may be able to present something interesting later. Plate frames were thrown at me very vigorously and with the force of strong arguments. I do not believe the vital question in frames is whether they should be of plate or bar construction. If English and French locomotive frames were not so thoroughly braced laterally, the plate construction would go to pieces as rapidly as bar frames. If our bar frames were as thoroughly braced as the foreign plate frames, they could not possibly give the trouble which we are not experiencing. The de Glehn compound at Belfort, for the Pennsylvania, was in the stage of construction which emphasized the strength and rigidity of the frames, both vertically and laterally. (See AMERICAN ENGINEER, June 1, 1904). I was surprised to find the frames so deep and to find such deep and solid cross bracing. On page 8 of the January, 1904, number of this journal the frame experiments on the Lake Shore and Michigan Southern were described, and on page 13 of the same number the new method of bracing across the engine with a large and deep steel casting was described. Now, this is exactly the thing which English and French designers have been doing for years. It probably explains the success of plate frames over here. With such bracing we might profitably experiment with plates because of their absolute integrity and their great vertical strength. This form would dodge the difficulties with welded iron frames and would avoid the tribulations of those who design and cast frames of steel. Some of our recent locomotives have frames of which about one-third of the length are slabbed. It would be easy to try a larger proportion of slab (plate) section as an experiment. Breakage of frames is now so serious with us as to justify such an experiment. G. M. B.

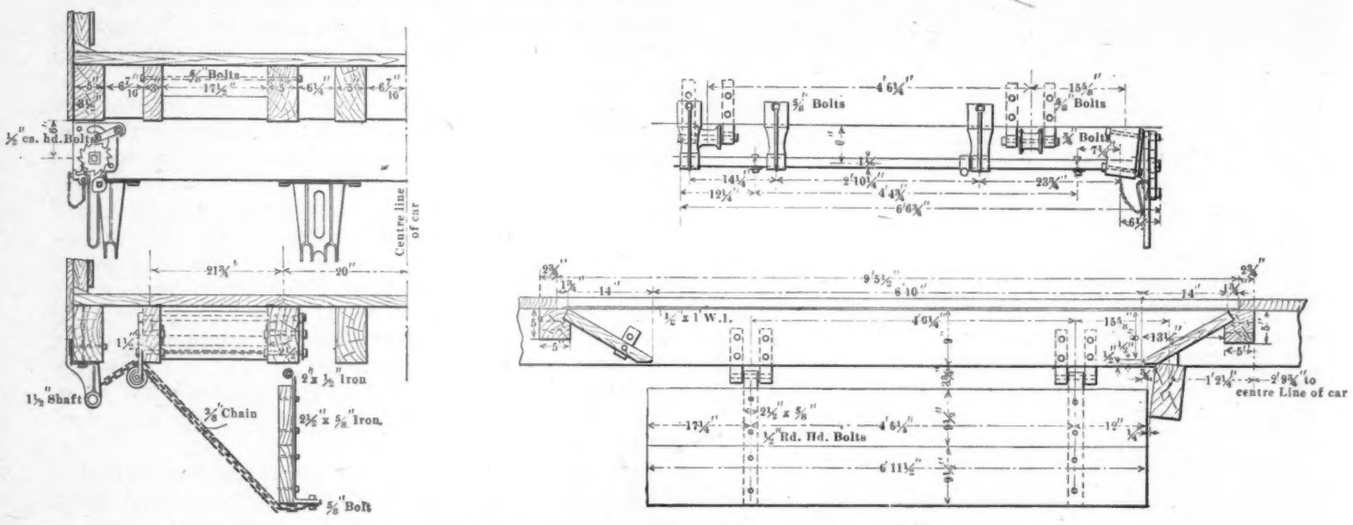
(To be continued.)

HOPPER BOTTOM BOX CARS.

CHICAGO, BURLINGTON & QUINCY RAILWAY.

This road is operating 1,000 box cars each fitted with 4 hoppers, as illustrated in the accompanying engravings. They are proving of considerable value to shippers, particularly in coal trade, where the cars may be unloaded over chutes. The cars are 40 ft. long and of 40 tons capacity.

The sectional drawing shows the arrangement and sizes of the sills, truss rods and the construction of the hoppers, which are placed between the intermediate sills, with sloping ends and closed by substantial doors, held by chains. An inside door fits the opening in the floor, giving a continuous flush floor over the hoppers when the loading is other than coal. These doors are removable and are secured to the side of the car above the girts and held by buttons when coal is to be loaded.



DETAILS OF HOPPER DOORS ON C., B. & Q. BOX CARS.

With four floor openings, each 17½ in. x 6 ft. 10 in., a load of coal is very easily removed and it is evident that the car must be popular with those who are prepared to take advantage of its construction. The drawing was supplied for this description by Mr. C. B. Young, mechanical engineer of the Chicago, Burlington & Quincy Railway.

NEW TURBINES AT NIAGARA—Two of the new 10,000-h.p. turbines of the Canadian Niagara Falls Power Company were started January 2 with completely successful results, each generator developing 12,000 volts.

THE RAILROADS AT THE EXPOSITION.—In its World's Fair number, dated December 31, the *Railway and Engineering Review* brought out the largest and finest special edition which we have ever received. It is devoted to the transportation exhibits at the World's Fair in St. Louis, and constitutes a fitting presentation of the department of transportation, over which Mr. Willard A. Smith presided as chief. With 286 pages and 619 illustrations, these important exhibits are presented in an appropriate manner for preservation by those who look upon universal expositions as bench-marks of progress. Nothing in the department is omitted or slighted, and the entire work is ably and artistically treated. As to the progress represented, it is interesting to know that the average weight of the locomotives at St. Louis is greater than the heaviest locomotive exhibited at the Chicago World's Fair in 1893. Track, terminals, signals, bridges, tunnels, the materials of engineering work, rolling stock, machinery and statistics are all included in such form as to render the number convenient as well as valuable as a record. Mr. Willard H. Smith, president of the *Railway and Engineering Review*, and his staff are to be congratulated upon this production.

HEAVY PASSENGER TRAIN IN ENGLAND.—The London & Northwestern is handling passenger trains of 20½ coaches, weighing 400 tons, behind the tender, at average start-to-stop speeds of 54 to 55.4 miles per hour over very easy grades. According to Mr. Rous-Marten, the new passenger locomotives of this road are called upon to haul trains weighing as much as 500 tons.

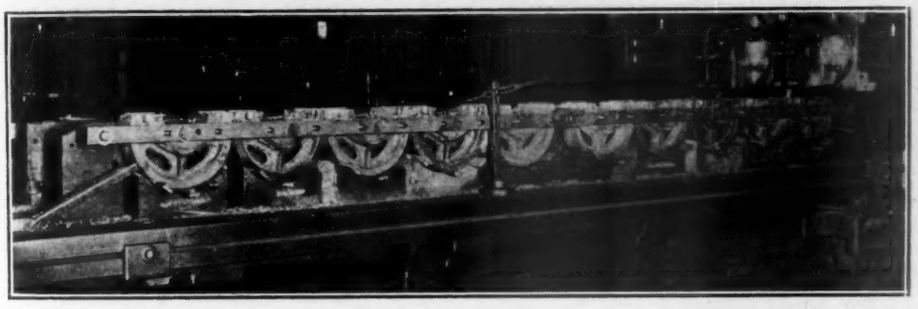
PRODUCTION IMPROVEMENTS.

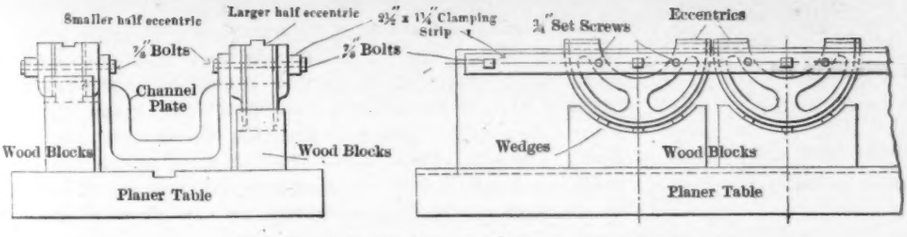
WEST ALBANY—N. Y. C. & H. R. R. R.

RAPID PLANING OF ECCENTRICS.

A reduction of 14 hours in the time required for setting up and planing 10 eccentrics—20 halves—was effected at the West Albany shops of the New York Central Railroad by improving the clamping device for holding the eccentrics. The long channel plate shown in the drawing has a tongue which fits into the groove in the planer table and keeps it central. The eccentric halves are supported by the hard wood blocks and are leveled by wedges. At each half a ⅞-in. bolt is passed through the flange of the channel plate and the 2½ x 1¼-in. clamping strip. To hold the eccentrics more securely and thus permit heavy roughing cuts to be taken ¾-in. set screws are passed through the clamping strip, as shown.

Two hours are required to set the 20 halves in place and 3 hours are required for the planing. A roughing and a finishing cut are taken with high speed steel at a cutting speed of 25 ft. per minute on a Niles planer about 25 years old. The old method was to hold each eccentric half by a forked clamp with one bolt. This did not hold them very securely, and it was necessary to take 3 cuts; the total time for setting up and planing requiring about 19 hours. We are indebted for this information to Mr. L. H. Raymond, general foreman at West Albany, and to Mr. John Heim, the machine operator. This is excellent work for an old machine. Space will be gladly supplied in these columns for records and methods as good or better than this, either on an old or new machine.





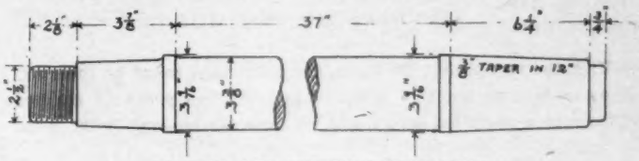
METHOD OF CLAMPING ECCENTRICS ON PLANER.

TURNING AND FITTING PISTON RODS.

These steel rods, the general shape of which is shown in the sketch, are from 46½ to 51 ins. long for those of 3⅜ ins. diameter and up to 60 ins. in length for those of larger diameter. In place of doing the lathe work on a pair of these rods in 12 hours, as was done formerly, 5 or 6 rods are now turned out in 9 hours.

The first operation is to turn the rough 3¾-in. rod to within 1-16 in. of its finished size. This is done at a cutting speed of 90 ft. per minute, with a feed of 3 ins. per minute. From 15 to 25 minutes are required to rough turn, cut off to length and recenter. About ten minutes are required to finish the body of the rod, which is done at a cutting speed of 150 ft. per minute. Fitting the taper end to the crosshead and driving it to within ⅛ in., which is left for the key to draw, takes about 13 minutes. After marking the rod for the keyway, it is again placed in the lathe, and about 15 minutes are required for fitting the piston head end. After the thread is cut and the nut fitted, which requires about 10 minutes, the rod is passed to the man who cuts the keyway and assembles, ready for the engine.

From 1½ to 2 hours are required for the lathe work, and about 2 hours for putting in the keyway and assembling. This information is furnished by Mr. Louis Schlebecker, who, during the month of December (280 hours) rough-turned 110 rods, recut and finished 120, fitted to crossheads 96, fitted to piston heads 108, cuts threads on 67 and straightened 4.



TURNING AND FITTING PISTON RODS.

FORTY CENTS PER MILE.

The Congo State Railway presents an example to the traffic managers of the world, which undoubtedly many would like to follow, in order to improve the figures shown in their annual reports. According to Mr. D. C. Snyder, a missionary from West Africa, who is spending a vacation in this country, this road is 260 miles long, running from Matadi, at the mouth of the Congo, to Stanley Pool. Twenty-four hours is required for the trip. Mr. Snyder states that the first-class passenger fare is $100 and that the station agents do not go through the formality of selling tickets. Second-class fare is $10. There is but one passenger train, which runs on alternate days. The cars are very uncomfortable and the trip is referred to as misery and torture. In spite of the extarordinary tariff of 40 cents per mile the number of passengers averages about 15 per trip and even at these rates people are fortunate to ride, as the only alternative is to travel through the jungle for three weeks with native guides. The grades are very heavy and probably the road pays better than any other line in the world, as a great deal of freight is carried in addition to the passengers. Imagine the character of the annual report which the Pennsylvania Railroad would be able to make if its passenger tariff was on a 40-cent basis!

PROGRESS IN LOCOMOTIVES.—Within the personal experience of the speaker, the Chicago & Northwestern Railway has doubled the total weight of its average locomotive, and has also doubled the available tractive power. In 1874 this railway owned 300 locomotives; the smallest had 8½ x 12-in. cylinders, weighed 20,000 lbs. and had a tractive effort of but 2,000 lbs. The largest weighed 70,000 lbs. and had a tractive effort of 14,600 lbs. The average of the 300 was about 55,000 lbs. weight, and 10,160 lbs. tractive effort. Comparing the first 300 locomotives with the last 300 which have been put into service, we find that the weight has nearly trebled, increasing to 145,000 lbs., and the tractive power has increased 2½ times to 25,700 lbs. The smallest of these last locomotives weighs 95,000 lbs. and develops a tractive power of 18,500 lbs., while the largest weighs 162,000 lbs. and exerts a tractive effort of 30,900 lbs. Another comparison in bold figures is that the total weight of the original 300 engines was 8,283 tons, while that of the last 300 was 21,803 tons.—*Robert Quayle, before students of Ames College.*

WATER SOFTENING.

CONTROL AND RESULTS FROM A CHEMICAL STANDPOINT.

BY G. M. CAMPBELL, P. & L. E. R. R.

(*Continued from Page 17.*)

With the equipment on hand, the attendant must be instructed as to how to use it. A set of instructions properly framed is therefore supplied and hung up at a convenient point near the cabinet. Instructions for Whitsett Junction are shown in Table 1. The wording may not be the best, but the endeavor was to make the language such that any ordinary workman could fully appreciate and understand it. These printed instructions are, of course, supplemented by verbal ones with any new attendant. After the attendant has made his tests according to the rules just laid down, the next step is the charging of the chemicals and the general operation of the machine. Instructions for this purpose are supplied; those for Whitsett Junction are given in Table 2.

The exact amount of soda and lime required is given in framed tables. The soda table in use at Williamsburg is shown in Table 3, and the lime table in use at Pittsburgh is shown in Table 4. In the Kennicott machine proportionate soda treatment is taken care of by altering the amount of the solution of saturated lime water used; this latter is accomplished by varying the size of the opening in the pipe admitting water to the lime chamber. Fluctuation in the pumping rate, and the consequent required change in amount of chemicals used, is taken care of by the well-known principle of the litt pipes operated by a float in the raw water box; the head over all openings remains equal. The proportioning of the chemicals is thus independent of the rate of pumping.

The attendant has, it is assumed, made his tests and run in his charges. If the treated water is not of a proper quality the fault is not his, provided, of course, the machine is in good mechanical condition and he has followed instructions in testing and charging. He, however, tests the treated water for record purposes. If this was the limit of control over the softeners, water softening would without doubt be a failure, except at such points where a thoroughly reliable and efficient man was in charge. Means for checking results have to be provided. The first check is in weekly reports, which are forwarded to headquarters. A sample report, that for Pittsburg for the week ending November 26th, 1904, is given in Fig. 1,

THE PITTSBURGH & LAKE ERIE RAILROAD COMPANY

REPORT OF Pittsburgh WATER SOFTENING PLANT

For week ending 11-26 1904.

DAY	PUMPING				RAW WATER			CHARGES							TREATED WATER			
	Started	Stopped	Hours Pumped	Gallons Pumped	Hardness	Acidity Alkalinity with Red Indic.	Acidity with Clear Indic.	SODA Pounds	SODA Time of Charge	LIME Pounds	LIME Time of Charge	COAGULANT Copperas Pounds	COAGULANT Alum Pounds	COAGULANT Time of Charge	Hardness	Alkalinity with Red Indic.	Excess of Lime CAUSTICITY	Time of Test
Sunday	8:00 A	1:20 P	5:20	80,000														
	6:20 P	6:10 P	1:50	27,500	23	0.5	10.5	184½	10:30 A	53	10:30 A				5.0	5.5	6.0	10:00 A
Monday	7:30 A	11:10 A	3:40	55,000														
	3:30 P	6:05 P	2:35	38,750	24	0.5	9.5	203	8:45 A	60½	8:45 A				5.5	4.5	4.5	10:00 A
Tuesday	7:30 A	1:15 P	5:45	86,250				216	8:30 A	49½	8:30 A							
	4:50 P	8:10 P	3:20	50,000	24	0.5	8.5	216	6:05 P	49½	6:05 P				5.0	5.0	5.0	10:00 A
Wednesday	7:45 A	1:00 P	5:15	78,750														
	5:15 P	9:30 P	4:15	63,750	24	0.6	9.0	216	11:45 A	49½	11:45 A				5.0	5.5	5.5	10:00 A
	3:00 A	3:20 A	1:20	20,000														
Thursday	7:45 A	11:00 A	3:15	48,750														
	4:20 P	6:55 P	2:35	38,750	24	0.7	10.5	216	8:15 A	49½	8:15 A				5.0	5.5	6.0	10:00 A
Friday	7:30 A	12:20 P	4:50	72,500														
	5:45 P	6:40 P	2:55	43,750	24	0.6	10.	216	8:30 A	58	8:30 A				5.0	6.0	6.0	10:00 A
Saturday	7:30 A	2:30 P	7:00	105,000				216	7:30 A	55	7:30 A							
	3:30 P	4:50 P	1:20	20,000	24	0.9	10.	216	1:30 P	55	1:30 P				5.5	5.5	5.5	10:00 A
Weekly Totals			55:15	828,750	24	0.6	9.7	1899½		479½								
Daily Averages																		
Amount of Soda and Lime used per 1000 gallons pumped								8.214		10.570								

Stock on hand:—Soda. 2½ bags. Lime, 38 bbls Copperas, 2 BBLS & 5 SACKS lbs. Alum, 1½ BBLS. less

Supplies required,

Remarks:

Mail copy of this report to Supt. M. & W. S., Pittsburgh, every Monday morning. Keep copy for yourself

Geo. Edmunds, Attendant.

FIG. 1—WEEKLY REPORT SHEET.

THE PITTSBURGH & LAKE ERIE RAILROAD CO.

DAILY REPORT FROM

Groveton WATER SOFTENER.

Date, 11-22-'04

RAW WATER (Sample taken from Raw Water Box):

TIME OF TEST	HARDNESS	ALKALINITY (Red Indicator)	ACIDITY (Clear Indicator)
7:30 A.M.	13	4	2
3:30 P.M.	13	4	2

TREATED WATER (Sample taken from Storage Tank):

TIME OF TEST	HARDNESS	ALKALINITY (Red Indicator)	CAUSTICITY (Clear Indicator)
7:30 A.M.	5	6½	7
3:30 P.M.	5½	6½	7

TREATED WATER (Sample taken from Soft Water Box):

TIME OF TEST	HARDNESS	ALKALINITY (Red Indicator)	CAUSTICITY (Clear Indicator)
7:30 A.M.	4½	6½	7
3:30 P.M.	5	6½	6½

DEPTH OF WATER:

TIME OF READING	OVER RAW WATER SLOT	OVER SOFT WATER SLOT	OVER SODA SLOT
10:00 A.M.	14½"	15"	15"

NOTES.—Two samples are to be tested from Soft Water Box.
Tests of the Raw water and of the Treated water from the Storage Tank are to be those made for the weekly report sheet.
Depth of water to be measured once each day.

REMARKS: No. 2 soda tank lasted till 4:30 P.M.

M. L. Ralph.

NOTE.—This Daily Report Sheet is to be used when called for. Send original, each day to G. M. CAMPBELL, Pittsburgh, Pa.

FIG. 2—DAILY REPORT SHEET.

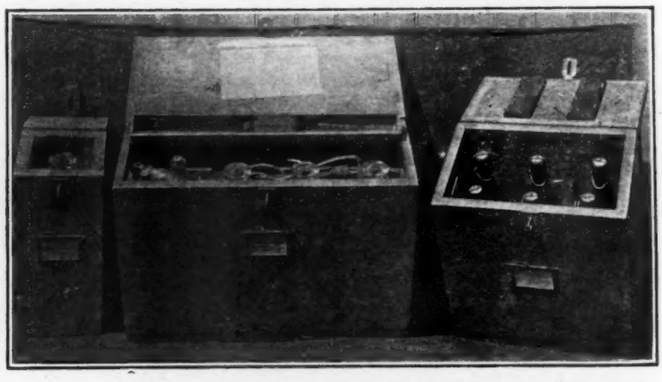


FIG. 3—TRAVELING CASES FOR DISTILLED WATER, TESTING OUTFIT AND SAMPLES OF WATER.

size of sheet being 8 x 10½ ins. This report is a record of all tests made, chemicals used, water pumped, etc. The amount of chemicals shipped to the softener is kept account of, and the amount stated to have been used can be easily checked up; there is also a definite relation btween the number of gallons pumped and the length of time the soda charge lasts—this relation is found experimentally for each softener, and any error in reporting can be detected, especially at points where meters are installed.

In addition to this weekly report, the attendant sends in a daily report, so that if anything goes wrong at the softener, such as the clogging up of feed pipes, wrong adjustment of lift pipes, etc., it can be noted within 24 hours, and corrected. Sample report, that from Groveton for November 22d, 1904, is shown in Fig. 2, size of sheet being 5¼ x 8 ins. This report shows whether the softener is working uniformly—that is, there should be nearly uniformity between samples from soft water box, which contains water just after passing through

TABLE 1.

PITTSBURGH & LAKE ERIE RAILROAD COMPANY.

WHITSETT JUNCTION WATER SOFTENER.

TESTING.

Bottles.—Use the square 8-ounce bottle for Hardness and the round 4-ounce for Alkalinity (or Acidity to Red Indicator), and the 8-ounce round ones for Acidity and Causticity. Always use the same bottle for the same purpose. Always thoroughly rinse out the graduated cylinder or bottle before using it with the same kind of water as you are going to test.

Indicators.—The Red Indicator is for testing for Alkalinity and Acidity, and the Clear Indicator for Acidity and Causticity.

Raw Water.—Get sample from raw water box. Test it before the addition of every lime or soda charge. For the soda charge, test for both Hardness and Alkalinity or Acidity to Red Indicator. For the lime charge test for Alkalinity (or Acidity to Red Indicator) and Acidity.

Treated Water.—Take sample morning and afternoon each day from the special tap in the discharge line from the tank and test for Hardness, Alkalinity and Causticity. Add result to weekly report sheet.

Alkalinity.—Measure 100 C. C. of the water and put into the proper bottle and add 3 or 4 drops of the Red Indicator; water will then be slightly yellow if it is Alkaline. If it is red there is no Alkalinity. Fill up the Acid burette to the zero mark, then run this into the water a few C. C. at a time at first, and one or two small divisions toward the end, shaking the bottle a little. As soon as the water remains a very light red color after shaking, the test is finished. The number of C. C. of solution used is the Alkalinity.

Acidity to Red Indicator (make this test only when there is no Alkalinity).—Measure 100 C. C. of the water and add to proper bottle; add 3 or 4 drops of Red Indicator, water will then be orange color or red. Fill up the Soda burette to the zero mark and run this slowly into the water till the color just changes to yellow after shaking; the test is then finished. The number of C. C. of solution used is the Acidity to red indicator. Put this result in the Alkalinity column of report and mark "Acid" after it.

Acidity to Clear Indicator.—Measure 200 C. C. of the water to be tested, add to proper bottle and add 5 or 6 drops of the Clear Indicator. If the water turns at once and remains a pink color, there is no Acidity. Fill up the Soda burette to the zero mark, then run this into the water one or two C. C. at a time, and shake bottle. As soon as a faint pink color remains after shakng, test is finished. The number of C. C. of solution used is the Acidity.

Causticity.—Measure 200 C. C. of treated water, and put into proper bottle. Add 3 or 4 drops of Clear Indicator. Water will usually turn pink. Fill Acid burette to zero mark and run in a few C. C. at first and toward the end ½ C. C.. at a time, until the color disappears. The number of C. C. used is the Causticity.

Hardness.—Measure 100 C. C. of the water to be tested and put into the proper bottle. Fill the soap burette to the zero mark, then run this into the water to be tested, 1 C. C. at a time until there is nearly enough in, then only one or two small divisions at a time. Shake bottle vigorously after each addition of soap solution. Note lather carefully; if it disappears, add more soap, until you get the lather to hold for 3 minutes, with the bottle lying on its side. The number of C. C. of solution used is the Hardness. If Hardness of raw water is greater than 12, then take only 50 C. C. of raw water and add to it 50 C. C. of distilled water. Multiply the number of C. C. of solution used by 2 to get the Hardness. Note: if water is acid to Red Indicator before testing for Hardness add C. C. of Soda solution equal to the Acidity.

G. M. CAMPBELL.

Pittsburgh, November 30, 1904.

TABLE 2.

PITTSBURGH & LAKE ERIE RAILROAD COMPANY.

WHITSETT JUNCTION WATER SOFTENER.

TESTING.

Examine slots in raw water box, soft water lift pipe and soda lift pipe to see that they are unobstructed. Examine all valves to see that they are working properly, especially Soda float valve.

DUMPING.

Main Tank.—Dump the main tank below top of top filter plate each morning before starting to pump, and every six hours the machine is in operation during the day.

Lime Saturator.—Dump Lime Saturator every Saturday. This is done to get rid of stones and undissolved lime. No exact time can be given for this—the attendant will have to tell from experience just how long to hold valve open, usually 10 to 20 seconds will do.

CHARGES.

Soda.—Test Raw Water just before it is time to turn tank into service. Take the difference between Hardness and Alkalinity or the sum of Hardness and the Acidity to Red Indicator, then add to the tank sufficient Soda to make the total amount in the tank whatever the table calls for. Most of the charge should have been in for several hours. Immediately after a tank has been emptied, fill it with water and put into it, through the wire basket, about 12 pounds less than total amount of Soda in the other tank and thoroughly stir, the balance to be put in according to test at time tank is turned into service. For example, suppose No. 1 tank has a full charge of 45 pounds of Soda and is turned into service, No. 2 is at once filled and given a charge of 33 pounds. When No. 1 is nearly empty test water and consult table. Suppose 49 pounds are required; as 33 are already in, it will be necessary to add only 16 to bring total to 49. When charging No. 1 you would start it with 37 and so on. Enter on the report the total pounds in the tank and the time you made the test just before turning tank in. After a tank has been turned into service do not add any more Soda, even though Raw Water may have changed. Use it up just as it stands.

Lime.—Test the water for Alkalinity or Acidity with the Red Indicator and for Acidity with the Clear Indicator. Take the Acidity with Clear Indicator and add to it the Alkalinity or subtract from it the Acidity with Red Indicator, according to which ever is present, and from the table find out the amount of lime required; mix up in the Lime Slaking Box the amount of lime called for by table. This should be done long enough before lime charge is required to get it into a soft paste. At the proper time run the whole charge into Lime Saturator, do this slowly—take 10 or 12 minutes—otherwise pipe might get clogged at bottom; use as small an amount of water as possible. Adjust the Lime slot carefully, according to table, as called for by the test. Always adjust slot after making a test, even though a lime charge is not due.

SAMPLES.

Always thoroughly rinse out the cup or bottle in which sample is taken. Raw Water should be taken from the Raw Water Box after the pump has been running for at least ten minutes.

Treated Water should be taken from the special tap in the discharge line from the tank.

Samples to be sent to Pittsburgh of the raw and treated waters should be collected at the time of making the first test on Monday, Wednesday and Friday—raw water in the dark bottles and treated water in the clear bottles. Be careful to put the bottles in the right compartment in the box.

G. M. CAMPBELL.

Pittsburgh, November 30, 1904.

TABLE 3.

PITTSBURGH & LAKE ERIE RAILROAD COMPANY.

WILLIAMSBURG WATER SOFTENER.

SODA TABLE.

December 2, 1904.

Hardness less Alkalinity or Hardness plus Acidity. (Red Indicator Only). Degrees.	Soda. Pounds per Charge.
1	6
2	12
3	18
4	24
5	30
6	36
7	42
8	48
9	54
10	60
11	66
12	72
13	78
14	84
15	90
16	96
17	102
18	108
19	114
20	120
21	126
22	132
23	138
24	144
25	150
26	156
27	162
28	168
29	174
30	180

The Acidity in the table is the Acidity to Red Indicator only.

This charge should treat about 60,000 gallons of water and should last about 6 hours, but the time may vary from 5 to 7 hours according to rate of pumping..

G. M. CAMPBELL.

TABLE 4.

PITTSBURGH & LAKE ERIE RAILROAD COMPANY.

PITTSBURG WATER SOFTENER.

LIME TABLE.

December 2, 1904.

Acidity with Clear Indicator plus Alkalinity with Red Indicator or less Acidity with Red Indicator. Degrees.	Slot. No. of Degrees.	Lime. Pounds.
1	4	5
2	8	10
3	12	15
4	16	20
5	20	25
6	24	30
7	28	35
8	32	40
9	36	45
10	40	50
11	44	55
12	48	60
13	52	65
14	56	70
15	60	75
16	64	80
17	68	85
18	72	90
19	76	95
20	80	100

Run in the charge of lime at the same time the soda tank is turned into service; this will be about every 6 hours, but the time may vary from 5 to 7 hours according to rate of pumping.

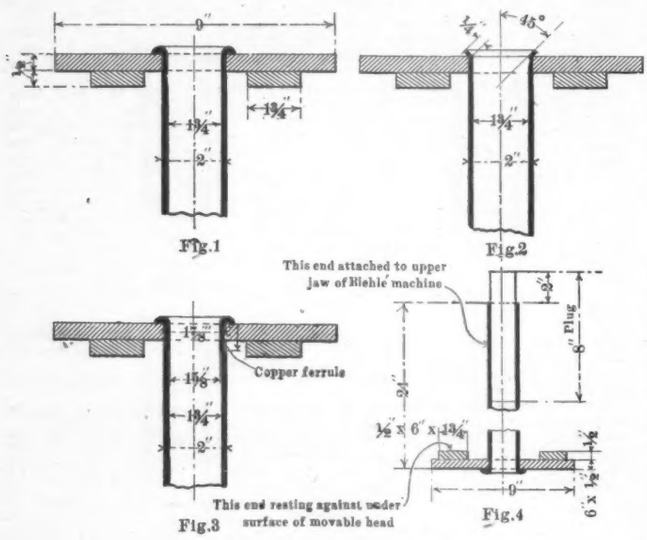
G. M. CAMPBELL.

the softener, and there should also be agreement between the water from soft water box and that from storage tank, though on account of the capacity of the storage tank, a time element enters so that, for example, water that passes through softener one day might not leave storage tank till two days later. On this report, the depth of water over slots is given—first, to show whether all lift pipe attachments are correct, and, second, to show rate of pumping; the rate for various depths of water is determined by experiment. As a check to prevent any falsification of records, samples of raw water and of treated water are collected at the time of the first test on Monday, Wednesday and Friday; raw water is collected in amber-colored bottles, treated water in clear. These bottles, 30-oz. metal-stoppered, are kept in a small shipping case, shown at right-hand side in Fig. 3. Each bottle has its own compartment, so that no labeling of samples is required. On Friday, when all the bottles are full, the case is locked and shipped to Pittsburgh, where the samples are tested. A duplicate case has in the meantime been sent to the softener, so that the attendant is always in possession of a full set of bottles. The card in the holder has the Pittsburgh address on one side and the softener address on the other; the proper return of all cases is thereby assured.

(To be continued.)

SECURING ARCH TUBES IN FIREBOXES.

While the construction often necessitates the use of a particular method of securing the arch tubes in the tube sheet, yet even when it is possible to get at the end of the tube through a hole in the throat sheet there is considerable difference of opinion as to the best method of securing it. A prominent railroad recently made a series of laboratory tests to determine the best method. The results were very conclusive. Tubes secured as shown in Figs. 1 to 3 were pulled in a Riehle testing machine. The tests do not exactly represent practice, because the steel plates into which the tubes were secured bore against two bars of ½-in. plate, placed close to the tubes. This, however, is not believed to materially



SECURING ARCH TUBES IN FIREBOXES.

affect the results. The practice of this road is to roll the arch tubes to the sheets and expand them, as shown in Fig. 2, leaving a projection of ½ in. after expanding. This form removes the end of the tube from the hot sheet, and it has been found satisfactory in service.

An average of three tests of the arrangement shown in Fig. 2 showed a holding power of 27,140 lbs., as against 24,055 lbs. for Fig. 1 and 19,470 for Fig. 3. This would indicate a marked superiority of the form represented by Fig. 2.

	No. of Tests.	Holding Power, lbs. Max.	Min.	Mean.	Remarks.
Fig. 1..	6	25,830	20,830	24,055	Rolled to sheet and beaded.
Fig. 2..	3	28,730	23,960	27,140	Rolled to sheet and expanded.
Fig. 3..	2	21,280	17,660	19,470	Rolled to sheet, beaded, swedged to 1⅞ in. for copper ferrules.
Fig. 3..	1	....	....	16,560	Rolled to sheet and expanded, swedged for copper ferrule.

THE STEADFAST MAN.—The technical school is not exclusively for the brilliant man. Much of the world's best work is done by the man of slow-moving intellect, to whom the good Lord has given the greater treasure of persistence, of steadfastness, with enough of imagination to feel what is concealed within the cloud on yonder difficult and distant hill.—*John C. Freeman.*

CARE OF SMALL TOOLS.

To the Editor:

With growing complexity of modern railroad business the question of system in the handling of tools becomes an important and increasingly difficult one. Superintendents of shops, master mechanics and foremen will generally, when asked, admit that the problem does not permit of ready solution and that they have much difficulty in arriving at satisfactory results. They will say that without a large clerical force and impracticable red tape no reliable record of tools supplied to men can be kept, that the *detailed* cost account of expenditures for tools is not ascertainable, that it is not practical on the whole to compel the return of tools to the tool room or to tell at all times what tools are on hand, whether these meet the actual requirements, what requisitions should be made to actually cover the needs of the work; nevertheless all of these men will recognize the desirability of some such system and will have at various times in their work attempted to establish something of this kind—oftentimes with considerable measure of success. If questioned still further they will recognize that only by eternal vigilance can a helpful system, once established, be maintained. This vigilance is usually too wearing on the master mechanic or other official in charge to enable him to carry it out unless he happens to have an excellent man looking after the tool question—and railroad companies do not as a rule offer sufficient inducement to this kind of man in such capacity.

But this whole problem, and really in a much more difficult form, has been worked out thoroughly and satisfactorily already. Libraries, large and small, are confronted with the same task of caring for a multitude of objects (books—intellectual tools we may call them) of varying value and usefulness; these are kept in a central store room, and are accessible at all times to those requiring them. They are to be allotted to these individuals, a record must be kept of each withdrawal, and a prompt return of these objects out an undue length of time compelled; they must be kept at all times ready for efficient use—that is, well repaired in case of damage—and replaced if worn out.

The parallel between a library and the tool equipment in a shop goes as far even as the value of the individual books and tools, the average cost of each of which may be taken at approximately $1; cape chisels might correspond to magazines, expensive art folios to pneumatic tools. But in this respect the library has the harder proposition. It deals with an irresponsible public, whereas the shop deals with men subject to discipline, even to financial indemnity, from pay-checks held back, in case of abuse of property. The number of the individuals and objects dealt with in the two cases is also much greater in the library than in the shop. The library, however, is run smoothly and its business transacted expeditiously—can the same be said of our railroad shop tool rooms?

Certain of our larger manufacturing enterprises (Westinghouse Electric Company, General Electric Company, National Cash Register Company, R. Hoe & Company, Link Belt Manufacturing Company, etc.—the list grows daily) have tackled the problem vigorously and are meeting with the success that the same methods have won in library practice, although methods evolved, we believe, independently; and following in the wake of these successful examples in the commercial world, some of our more important railroads have made determined efforts in the same direction, the Union Pacific, Santa Fe, and Northwestern line being examples. That is, these roads have found that it pays well to organize their shop tool system in a comprehensive and intelligent way, instead of leaving the problem to chance and individual caprice.

There is a branch, and an important branch, of this tool proposition which is peculiar to the railroad, namely that of equipping locomotives with tools. This phase of the problem is a serious

one, for often the presence on a locomotive of some tool or device (for example, eccentric set screw wrench, or valve stem clamp) will greatly lessen a delay. In some cases even an engine may be enabled to get home if the engineer has tools to work with instead of waiting to be towed. Few railroads, however, handle this matter in a consistent or helpful manner. The Union Pacific has good practice, the N. Y. Central and the Pittsburgh & Lake Erie, the Erie also good, and among small roads the Buffalo, Rochester & Pittsburgh may be mentioned as fully alive to, and in control of the situation. This question was not as important 20 years ago, just as small tools in the shop were not a problem, for in those days each mechanic possessed his own tools and cared for them, each engineer operated *his* particular engine and the equipment in each case was kept up by the man's pride and interest in his own work. With the coming of the large shop of modern days and with the advent of pooled engines operated day and night, the problem has developed to serious proportions; it is the change from the private library or personal corner book shelf to the public institution supplying, not only each man's needs, but all mens' needs.

On locomotives we have really the same problem as in the shop, that of giving out to individual certain tools and requiring care of the same, only in the one case we are dealing with the irresponsible locomotive and in the other with men whose attention we can compel. We must, therefore, make the engineer responsible for what belongs to his ward—the locomotive.

We can arrive at this in a practical manner by some such arrangement as follows:

1. Divide the tools into four groups: emergency tools, heavy tools, portable tools and engineer's equipment. 2. Emergency tools, comprising wrecking frogs, chain, spare brasses, fuses, etc., can be placed under seal. Inspection of the seal at roundhouses will determine whether the equipment has been tampered with, and if used the engineer must furnish report. 3. Heavy tools, such as fire hooks, push bars, journal box jacks, are not likely to be disturbed and may be left loose on the engine. 4. Portable tools should be kept under strong lock, preferably in iron boxes and these boxes either turned in to a common tool room on arrival at the roundhouse where they are inspected and missing tools accounted for, or left on the engine and there inspected. In this connection it should be noted that the ordinary padlock and hasp and staple are almost no protection against forcible opening of the boxes; a good Yale or Corbin lock with the staples *bolted* to the tool box are recommended for substantial and safe construction. 5. Engineer's tools consisting of torches, oil-cans, and possibly Stillson wrench may be taken care of by the engineer himself and kept in his own cupboard when not on the road. This method will encourage the engineer to be saving of his oil, although many railroads have other systems in connection with giving out and return of oil.

Let it be remembered that not only will economy of tool equipment result from the establishment of a thorough engine tool system, but also the tools will be on the engine when they are wanted, returning to the company many times the cost of both the tools and the system in the avoidance of vexatious delays and inconvenience to traffic. It is time that this important detail of practical railroad management receives the serious consideration of our large railroads.

"ONE WHO HAS DONE IT."

LOST MOTION IN LOCOMOTIVE SERVICE.

To the Editor:

In discussing the time service of locomotives the *Railway Age* of November 18 refers to the desirability of studying actual records in order to understand the delays as a means of reducing the time engines are idle. Interesting figures are given in the following quotations:

"Where such records have been obtained from special tests during a period of one month the following distribution of time covering the proportion laid up, in operation, and delays, was obtained for 3,000 miles in freight service, and a total of 715 hours: The total time in hands of motive power department at the roundhouse was 143 hours, or 20 per cent., delays on road due to motive power, such as engines not steaming, hot boxes, defective brakes, drawbars, etc., 14 hours, or 2 per cent., running time hauling train, 200 hours, or 28 per cent.; time in hands of transportation department when not making mileage, 357.5 hours, or 50 per cent. As the result of this large proportion of lost time and delays on road, the average running time was 15 miles per hour, the average equivalent speed for transportation, 5.2 miles per hour, and average equivalent for total time of test, 4.2 miles per hour. Results nearly similar to these were obtained from other divisions of the road with heavy traffic, where it was supposed that the motive power department was not furnishing sufficient power and was holding engines too long at roundhouses. By the time record as given above it was easily shown that the transportation department was responsible for much the larger part of the delays and for the low average speed obtained for transportation."

This interesting exhibit shows that the lost motion when in the hands of the transportation department amounts to exactly the total time in the hands of the motive power department plus that due to engine failures and delays because of hot boxes defective brakes and broken drawbars, plus the time consumed in actually hauling trains. This statement may be put into convenient form for railroad men to paste in their hats, as follows:

Period	1 month
Mileage	3,000
Hours	715
Days of 24 hours	29

	Hours.	Per Cent.
Total hours in hands of motive power department at roundhouse	143	20
Hours delay on road for which motive power department was responsible, *i. e.*, engine not steaming, hot boxes, defective brakes, draw bars, etc.	14	2
Running time hauling trains	200	28
Dead time in hands of transportation department when not making mileage	358	50
Totals	715	100

Average running time $\frac{3000}{200} = 15$ m.p.h.

M.p.h. based on total time $\frac{3000}{715} = 4.2$ m.p.h.

M.p.h. based on total time in hands of transportation department, $\frac{3000}{358 + 200} = 5.38$ m.p.h.

L. R. POMEROY.

WHAT CAN A FIREMAN SAVE?

To the Editor:

In the editorial on page 431 of your November number you offer arguments for educating enginemen, firemen and shopmen. I see no way to secure better service except by increasing the severity of discipline until all but the very best men are weeded out. I do not see how a fireman can effect a saving that amounts to anything. What we ask of him is that he gets the train over the road. That is a matter of brute strength and does not involve education, which would prove to be an expensive luxury in the future as it has in the past.

GENERAL MANAGER.

EDITOR'S NOTE.—What can a fireman save? What does he want to save when he sees coal dumped in bulk on his tender with no attempt to measure or weigh it? What inducement has he to save fuel when his engine has an overload and he has seen a light engine and caboose pull out to go over the division directly ahead of him? Evidently there is need of education in positions far higher in rank than those referred to in the editorial. This correspondent's plea for more muscle and less education seems like a voice out of the dark ages. Locomotive service has become so exacting as to require a high degree of physical strength in firemen, but this very fact is the strongest argument for education. The man who is trained to use his brains will get over the road when brute strength alone will fail. Doesn't everybody know this?

AN IMPROVEMENT NEEDED IN TRUCKS.

To the Editor:

My position as master mechanic and my observations in years past prompt me to call attention to a weakness in railroad rolling stock which, I think, should be remedied, and by so doing large sums of money and many lives could be saved. I refer to the present construction of car trucks, swivel trucks, so called. Trucks should be and can be secured more firmly to the car body. When a car is derailed, the body and truck separate. They do so with the slightest provocation and sometimes with very serious results. About the first thing a truck does when derailed is to swing around crosswise of the track, resulting in a general smash-up of all cars following, whereas if the derailed truck or wheels had kept on in a straight line and held fast to the car body until it had spent its force, or the derailment had been discovered and the train stopped, there would have been no serious results. You will readily see the advantage of this.

MASTER MECHANIC.

(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY BY

R. M. VAN ARSDALE.

J. S. BONSALL,
Business Manager.

140 NASSAU STREET, NEW YORK.

G. M. BASFORD, Editor.
R. V. WRIGHT, Associate Editor.

FEBRUARY, 1905.

Subscription.—$2.00 *a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union. Remit by Express Money Order, Draft or Post Office Order. Subscription for this paper will be received and copies kept for sale by the*

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Damrell & Upham, 283 Washington St., Boston, Mass.
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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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We cordially invite our many friends attending the conventions at Manhattan Beach in June to make use of our offices. Telegrams and mail addressed in our care will receive careful attention.

The advisability of improving the attachment of trucks to car bodies, so that in case of derailment the truck cannot swing too far out of line with the rails and the truck will be securely held to the car body, is suggested by a correspondent on another page in this issue. This suggestion is important. Such construction should be simple as well as effective and if the desired result can be accomplished without too radically changing present practice, the improvement will meet a widely recognized need.

Automatic stokers are very successfully entering the forging and heating furnace field. No radical changes in the furnaces seem to be necessary, and those who are using them find no disadvantages whatever thus far. Several types of "underfeed" stokers are used and the cheapest grades of bituminous coal employed. With hand firing it is impossible to use this coal in heating furnaces without producing a distressing amount of smoke, but with the stoker there is none whatever. Even oil furnaces have been replaced by stokers in one large forging plant and the cost seems to be to the advantage of the stokers. In this installation the stoker-fired furnaces discharge directly into the atmosphere of the shop, with no chimney connection whatever, so complete is the combustion. Of course volumes of gas are poured out, but this is hot and passes at once to the roof and out of the ventilators. The stoker people appear to be slow to appreciate the field which lies before them in forge shops. It is to be hoped that figures may be obtained showing the possibilities in connection with such work as is done in large quantities in railroad shops.

ROCK ISLAND POWER COMMITTEE REPORT.

No one can dispute the statement that the greatest operating problem before railroads to-day is that of the locomotive.

Even on small roads the motive power question is assuming an importance which was entirely unknown a few years ago, and to-day the most vital portion of railroad operating statistics are those involving the records of what locomotives are doing.

As railroads are combined into systems, the questions which are important in small units become proportionately more important in aggregation of properties in which a large whole is made up of a number of parts, each with different local conditions, and the concentration of a number of independent roads into one combined organization has brought problems with which few managements have prepared themselves to deal.

The Rock Island system, in its comprehensive examination of the motive power problem in a report, abstracts of which are being published in this journal, has prepared a document of very great value, as suggesting the sort of study which every railroad should make of the condition of its locomotives. If any large system of roads, recently brought together under one management, will examine the number of different types of locomotives bought within a period of, say, five years, the number will be surprising. While standardization may easily be carried far enough to obstruct progress and improvement, provision for the future should be made whereby locomotive equipment may be added in accordance with a carefully prepared plan, constructed in the interests of reducing the number of types for which shop facilities must be provided and repair parts must be carried in stock.

The existence of such a document is as highly creditable to the railroad system, as its character is creditable to Mr. T. S. Lloyd, general superintendent of motive power, and the members of the committee. No argument is required in support of the statement that every American railroad should know the condition of its locomotives and prepare a systematic program for the future, including an investigation of possible fundamental improvements, such as are reported in this interesting document. Fifty new locomotives have already been ordered in accordance with the report.

ROUNDHOUSE EQUIPMENT AND OPERATION.

Much needs to be said about the equipment of roundhouses because of the fact that those which were up-to-date and considered examples of ideal practice only three years ago are now considered obsolete. As locomotives become bigger and as their work increases, running repairs become more and more important and there will be an increased necessity for additional facilities for prompt emergency work. For example, a new roundhouse plant is described in this issue which provides 8 drop pits, and they will be needed.

As the roundhouse becomes more important, the man to manage it properly is preparing to become general manager, because there is no intermediate position which he cannot fill. Everything goes well when the master mechanic gives his attention to the movement of engines. Here seems to be the pivot around which the whole roundhouse problem turns, and it is necessary now, and in future will be more so, for the master mechanic to give more of his attention to what may be termed the operating part of his responsibilities.

The trouble is not alone with the roundhouse foreman. It is also with the master mechanic, who on most roads is usually insufficiently supported by assistants. On seriously considering the work which a division master mechanic is required to do, a business man must condemn his situation as absurd if not impossible. The time has come for separating the shop and road responsibilities and dividing the enormous amount of detail coming before the master mechanic. For the sake of both branches the responsibilities should be separated. This is not saying that master mechanics should not have charge of shops. It may be advisable that he should have the respon-

sibility of the shops, but he should have a capable shop superintendent who can relieve him from all care of the details.

What is needed is an organization which will permit of doing $10 worth of work in the roundhouse to save $100 worth in the shops, and will permit the master mechanic to personally look after such large matters as the operation of locomotives, engine failures, the economical use of fuel and the training of the enginemen. The shop problem is entirely different from this and should be dealt with by a man who is essentially a shopman. No one man can be outside and inside the shops at the same time.

THE MISCONCEPTION OF POWER OF STEAM LOCOMOTIVES.

In discussing electric as substitutes for steam locomotives it is important to be correct as to what steam locomotives are doing. Doubtless Mr. H. Ward Leonard and *The Electrical World and Engineer* will be glad to be set right as to an error which appeared in that journal on January 7, by Mr. Leonard in an article entitled, "Why Steam Locomotives Must Be Replaced By Electric Locomotives For The Heavier Freight Service." One of Mr. Leonard's paragraphs is as follows:

"A modern compound freight locomotive, which produces about 1,400 h.p. at 18 miles per hour, with a pull at the drawbar of 30,000 lbs., can produce as a maximum about 50,000 lbs. drawbar pull, but to do so will have to reduce its speed to about, say, 3 miles per hour, and will then produce only about 400 h.p."

This does not represent the facts and is an injustice to the steam locomotive. A drawbar pull of 50,000 lbs., which could be obtained with a cylinder tractive effort of about 53,000 lbs., would, at 3 miles per hour, represent 424 h.p.

$$\frac{53{,}000 \times 3}{375} = 424$$

However, such a locomotive would have at least 4,300 sq. ft. of heating surface. The Santa Fe Decapod (see AMERICAN ENGINEER, June, 1902, page 192) has a total heating surface of 5,390 sq. ft. and could use its maximum tractive effort up to a speed of 10 miles per hour. The highest speed at which a locomotive can utilize its maximum tractive effort is represented by the formulæ $125 \frac{HS}{TE}$; applied to this case the result is $125 \times \frac{4{,}300}{53{,}000} = 10$ m.p.h., and the corresponding h.p. is $\frac{53{,}000 \times 10}{375} = 1{,}410$ h.p., or 3.5 times the amount given by Mr. Leonard.

The substitution of electric for steam locomotives will be greatly facilitated if the real facts concerning the performances of the steam locomotives are considered in comparison.

FUEL CONSUMPTION OF LOCOMOTIVES.

The paper read by Mr. G. R. Henderson, before the American Society of Mechanical Engineers, which is printed in full in this number, is an exceedingly important document on the subject of locomotive operation, and one which may be profitably studied in connection with the four articles by Mr. Henderson, which were concluded in January, page 11. This method of studying the relation between speeds, loads, and fuel consumption of locomotives is of the utmost importance to railroad officials, as it provides a convenient method of examining locomotive performances with a view of using motive power effectively. While it is impossible to get an operating official to admit that he is practicing overloading on the one hand, or running freight traffic too fast on the other hand, it is easy to find examples of both of these faults of operation, and only by such a study as Mr. Henderson's recent articles render possible and convenient may it be known whether locomotive operation is what it should be.

It is to be hoped that these articles will have the serious attention of general managers, as well as motive power officials, not only from the standpoint of economy, but also from those of excessive engine failures and capacity in handling traffic over congested districts. Mr. Henderson's diagrams are easily applied, and should exert a strong influence for improvement in a field where marked improvements are becoming essential.

EDUCATION OF RAILROAD EMPLOYEES.

The busy reader should not turn from this subject because it is old. It is newer than ever, and the present conditions of railroad operation and of the labor problem give it an importance which it never had before.

Some able writers on this subject have considered the "higher branches" of railroading as a "profession" and stand for the education of a favored class for official positions. They wish to provide "for adequate training of the men destined to lead in the upper ranks of the service by extending the existing collegiate technical courses and enlarging the curriculum, more particularly so as to embrace general questions affecting railroad traffic, transportation, finances, law, administration, etc." Incidentally they point to the discouragements surrounding the subordinate railroad worker and consider it impossible to raise these men to obtain from their class those who are to lead in the higher positions.

This quotation voices the prevailing opinion of those who have looked to the technical schools for the training of men who are needed on railroads. Undoubtedly their arguments are strong and no one need quarrel with them or with anyone who is exerting efforts of any kind toward advancement and improvement. Let this good work go on, but there is another and infinitely more important need which thus far has not been seriously studied and another problem which has not been forcefully attacked. This is the education of the men within the ranks of subordinate workers in all departments It is these men, the lower class, who have supplied the leading and most successful officials, the men who have made American railroad practice. From this "class" will also come the best officials of the future. No arguments are necessary to support this statement.

These successful men from the ranks would be bigger, broader and even more successful if, in connection with their development, they had enjoyed privileges of education, which might easily have been given them. Others who worked beside them in the office, the shop, on the tops of freight cars, or on the tracks, who never would become leaders, would be better men had they also been provided with educational privileges.

What is needed on railroads to-day is the application of the principle developed by Mr. M. P. Higgins, of Worcester—the development of the men in the ranks as far as they can go. He says, in effect, educate a thousand good workmen. From among these may be found a number of foremen, a few subordinate officials and an occasional manager. This may be accomplished by educational work conducted by the railroads themselves, or under their immediate control. It may be approached in connection with methods of recruiting the service, and it may be carried far enough to fit those who are capable for short special courses, prepared for their needs at progressive technical schools.

We need to be reminded that many men in the ranks are sure to rise in one way or another. If they are not encouraged in every possible way to qualify for higher positions on the staff they will employ their leadership in other directions, and here is an opportunity to reach one of the roots of the labor problem which has already been allowed to wait too long.

It is well also to be reminded of the monumental failure of the Baltimore & Ohio Technical School for its employes. That school was sure, sooner or later, to fail. That attempt should not be repeated. It served not to show the difficulties and the

complications, but the simplicity of the problem. Instead of taking the student to the school, the school should be taken to the student and the needs of the telegraph operator, the section hand, the shop apprentice, the locomotive fireman, the clerk, provided for directly, inexpensively and effectively. Nothing would be gained by explaining how this may be done until the vital and general necessity for it is realized and understood. It may be done, and well done, by any railroad, large or small, the officers of which are prepared to make the effort. Heads of departments must work in hearty conjunction with the "school teacher," and the results will depend entirely upon the strong support and goodwill of the highest officials of the road. Only where this conjunction and support by the heads of departments and the highest officials are given to an educational movement has it the least chance to succeed. The first education required is that of the officials and owners of railroads.

American railroads would do well to study the educational development of 40 years by the British Admiralty. There is no harm in improving technical school training for railroad service, but a greater work lies nearer at hand and constitutes a far more vital need to-day—the education of the workers. This accomplished, the part to be played by the technical schools becomes easy and simplified, because the students know what they want and are prepared.

It is said that "school teaching is not the business of a railroad." When heard for the first time, this sounds like a conclusive statement of fact, and seems to settle the whole matter But it does not settle it. The railroad is the school of its own recruits and always will be, whether the recruits are apprentices or college graduates, sons of workmen or sons of the directors, and because a large majority never complete grade school studies some one must take them in hand. The railroads need *educated men* (for example: to fire a 100-ton locomotive).

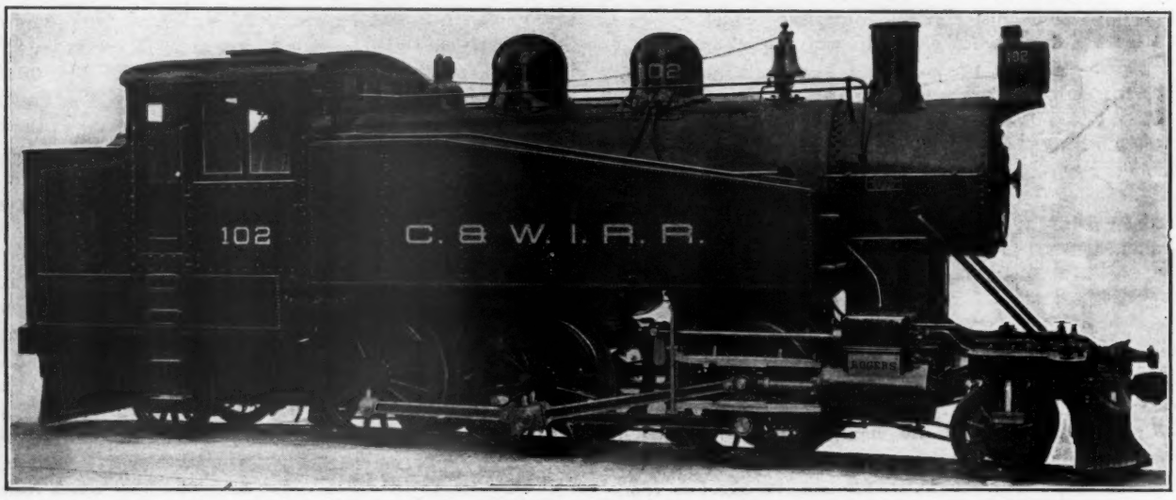
As long as the education of a class of men to become railroad officials is considered the vital question, the real problem will always remain; but when the education of the rank and file is provided the special preparation of officials will take care of itself.

BOSTON TUNNEL OPENED.—On December 30 the tunnel to East Boston was opened for traffic and is now used regularly by the Boston Elevated Railway. The harbor section is 2,700 ft. long and the depth of the earth between the top of the tunnel and the harbor is about 20 ft. When the harbor is dredged to 40 ft. the depth of earth will be about 5 ft. The leakage of the harbor section is only 8 gallons a minute, as compared with 8,000 gallons of the Mersey tunnel in Liverpool.

SIX COUPLED SUBURBAN LOCOMOTIVE.

2—6—2 TYPE—CHICAGO & WESTERN INDIANA R. R.

The Rogers Locomotive Works have built a number of locomotives for suburban service on the Chicago & Western Indiana Railroad in Chicago. They have side tanks, and in both appearance and arrangement resemble locomotives for similar service on the Central Railroad of New Jersey (AMERICAN ENGINEER, June, 1902, page 200). For convenience in keeping a record of recent suburban locomotives, the leading dimensions of three other typical designs are presented in the accompanying table. The appearance of the Rogers design is greatly improved by placing the headlight in front of the boiler. These engines are adapted for running in either direction. They have moderately wide fireboxes. An increase of 500 gals. in tank capacity above that of the Philadelphia & Reading and the Central Railroad of New Jersey designs is obtained by placing a supplemental tank under the cab, which brings the capacity up to 3,500 gals. The tanks are connected by pipes shown in the engraving. The coal capacity is 5 tons.



SUBURBAN LOCOMOTIVE, CHICAGO & WESTERN INDIANA RAILROAD.—ROGERS LOCOMOTIVE WORKS, *Builders.*

The boiler has a straight top, with radial stays. The trailing wheels are 42 ins. in diameter, and the trailing axles have 8 by 13½-in. journals. The tractive power of this engine is exactly the same as that of the Central of New Jersey, 22,700 lbs.

FOUR TYPICAL SUBURBAN LOCOMOTIVES.

Name of railroad	N. Y. C.	C. R. R. of N. J.	P. & R.	C. & W. I.
Road number	1410	200	381	102
Builder	American	Baldwin	Baldwin	Rogers
Type	Simple	Simple	Simple	Simple
When built	1902	1902	1903	1905
Weight, total	216,000	189,900	201,700	190,000
Weight on drivers	128,000	129,000	120,860	130,000
Weight, leading truck	.....	21,900	19,120	20,000
Weight, trailing truck	.....	39,000	61,920	40,000
Wheel base, driving	15-0	14-0	12-6	14-0
Wheel base, total	35-9	31-8	30-9	31-2
Driving wheels	63	63	61⅝	63
Cylinders, diameter	20	18	20	18
Cylinders, stroke	24	26	24	26
Heating surface, firebox	162	96.6	156.3	146.5
Heating surface, arch tubes	.....	43.0	.....	.....
Heating surface, tubes	2,275	1,695.0	1,825.5	1,694.9
Heating surface, total	2,437	1,834.6	1,981.8	1,841.4
Firebox, length	93	109	94	102
Firebox, width	97⅞	72	105	66
Grate area, sq. ft.	62.1	54.5	68.5	46.8
Boiler, smallest diameter	70	60	66	60
Tubes, No. and diameter	365-2	249-2	447-0	249-2
Tubes, length	12-0	13-0	9-0	13-0
Steam pressure	200	200	200	200
Reference in American Engineer and Railroad Journal	April, 1902 P. 115	June, 1902 P. 200	Oct., 1903 P. 364	Feb., 190

RIVETS IN A STEAMSHIP.—It is stated that 1,800,000 rivets, weighing 600 tons, were required in the construction of the new Cunard liner *Caronia.*

FUEL CONSUMPTION OF LOCOMOTIVES.*

BY G. R. HENDERSON.

The fuel bills of a railroad constitute ordinarily about 10 per cent. of the total expense of operation, or from 30 to 40 per cent. of the actual cost of running the locomotive. On important systems the gross amount of coal burned assumes a very large figure—running into millions of tons. Each engine will probably consume $5,000 worth of coal in a year on the average, so that for 1,000 locomotives the annual coal bill would approximate $5,000,000. While this is one of the largest items of expense, there is probably less actually known about it than any other account. We may know in a general way that an engine of a certain class, loaded with a definite tonnage, will haul its train in a given direction over a particular divison with a consumption of so many pounds of coal per 100 ton miles, but here our knowledge stops, and if it should be asked how much is used in ascending the maximum grade, how much on the subordinate grades, and what quantity on the level, there is little likelihood of receiving a correct answer.

The reason for this lack of definite information is not hard to find; in fact, it is quite obvious. While it is a comparatively simple matter to determine the quantity of coal used on a trip throughout a run, by means of track scales and measured supplies taken en route, it is very difficult and laborious to subdivide it between terminal points, in the proper proportion to the work done on each of the various grades. An approximation is sometimes obtained by counting the shovelfuls thrown into the firebox between different points, but this, of course, cannot be considered an accurate method. The ordinary exigencies of railroad traffic are so many and varied that it is almost impossible to maintain fixed conditions for a length of time sufficient to determine factors of unquestioned value.

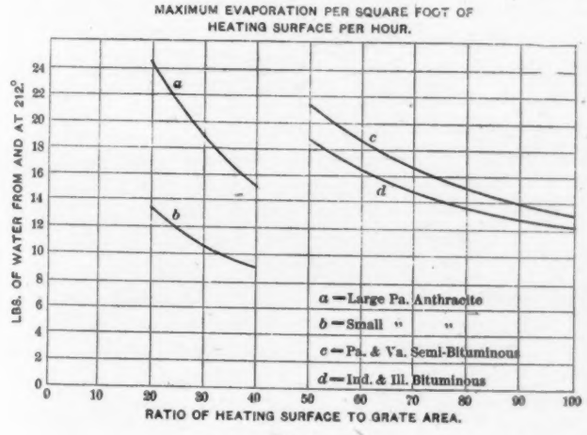

MAXIMUM EVAPORATION PER SQUARE FOOT OF HEATING SURFACE PER HOUR.
LBS. OF WATER FROM AND AT 212°
RATIO OF HEATING SURFACE TO GRATE AREA.
a—Large Pa. Anthracite
b—Small " "
c—Pa. & Va. Semi-Bituminous
d—Ind. & Ill. Bituminous

FIG. 1

The same comments apply equally to the consumption of water. Even if meters be placed in the feed pipes, the inconvenient location for observation and the variable methods of working the injector by allowing different heights of water in the boiler, not to speak of leaks and wastes, militate against accurate measurements. Thanks, however, to the "Locomotive Testing Plant," we are now able to work an engine for a long period under constant conditions, and at the same time make accurate measurements of the fuel and water consumed.

Several years ago, when connected with the Chicago and Northwestern Railway, the author was able to make a complete set of tests with the standard heavy freight engine of that road, first upon the testing plant and afterwards in road service with a dynamometer car. Using the results of these tests as a foundation, it has been found possible to elaborate a diagram for practically any particular locomotive whose general dimensions are known, which will give at once the coal consumption per mile or per hour for various grades and speeds or train loads. This diagram is based upon theoretical as well as practical considerations, and will, it is believed, give values agreeing closely with actual conditions.

The construction of the diagram and the method of using it can, perhaps, be made most clear by assuming a locomotive of certain proportions, and developing the study for this engine. We will therefore consider a consolidation locomotive or 2—8—0 type having the following general dimensions:

Diameter of cylinders	21 ins.
Stroke of piston	32 "
Diameter of drivers	56 "
Boiler pressure	200 lbs.
Grate area	40 sq. ft.
Heating surface	3,200 " "
Weight of engine and tender	150 tons.

The theoretical tractive force of such a locomotive will be

$$T.T.F. = \frac{P\ d^2\ s}{D} \quad \ldots\ldots\ldots 1$$

where P = Boiler pressure in lbs. per sq. in.
d = Diameter of cylinder in ins.
s = Stroke of piston in ins.
D = Diameter of drivers in ins.

When we allow for drop in steam pressure and internal resistance, we find that the available tractive force at circumference of the drivers is only 8-10ths of the theoretical tractive force, or,

$$A.T.F. = \frac{.8\ P\ d^2\ s}{D} \quad \ldots\ldots\ldots 2$$

for simple engines, when working at slow speeds with the reverse lever in the corner notch.

For the engine under consideration we therefore find as follows:

$$T.T.F. = \frac{200 \times 441 \times 32}{56} = 50{,}000 \text{ lbs. approx.}$$

$$A.T.F. = .8 \times 50{,}000 = 40{,}000 \text{ lbs. approx.}$$

As the speed of the locomotive increases, however, beyond the point where the boiler can supply the complete volume of the cylinders at each stroke, an earlier cut-off must be used, and it is necessary to determine the effect of such a change. In order that this may occur at the maximum possible speed, the boiler must be worked to its full capcity, which is limited by its ability to burn fuel. From various tests it seems as if this limit might be considered as stated below, the quantities being expressed in pounds of coal per square foot of grate area per hour:

Bituminous coal	200 lbs.
Anthracite, large sizes	100 "
Anthracite, small sizes	60 "

We will assume that our engine is burning Pennsylvania or Virginia semi-bituminous coal, therefore the maximum combustion will be $40 \times 200 = 8{,}000$ lbs. coal per hour. We admit that this is a large amount to be handled by one man for any great length of time, but there is no doubt that it could be burnt, if supplied.

In order to determine the quantity of steam generated by this amount of fuel in the boiler which we have assumed, Fig. 1 is introduced. This has been compiled from various sources of information, and, it is thought, fairly represents the average practice in this country. In this figure, the ordinates give the maximum evaporation in pounds of water from and at 212 deg. F. per sq. ft. of heating surface per hour than can be expected under ordinary conditions, as stated above, the abscissae denoting the ratio of heating surface to grate area. For the engine in question this will be

$$\frac{3200}{40} = 80,$$

and for semi-bituminous coal, curve c, we find that with a ratio of 80, 15 lbs. of water, from and at 212 deg. may be evaporated per hour from each square foot of heating surface, or for the boiler as a whole, $3{,}200 \times 15 = 48{,}000$ lbs. per hour.

*A paper read before the American Society of Mechanical Engineers.

The factor of evaporation from ordinary temperatures of feed water will be about 1.2, so that we shall have at boiler pressure, $\frac{48{,}000}{1.2} = 40{,}000$ lbs. per hour.

The steam will be somewhat reduced in pressure at the cut-off point, however, and the table here given indicates the probable relation of this pressure to the boiler pressure, when the reverse lever is in the corner notch, and the throttle wide open.

RATIOS OF CUT-OFF PRESSURE TO BOILER PRESSURE.

Revolutions per Minute .	Starting.	50	100	150	200
Long ports	.98	.94	.88	.83	.78
Short ports	.98	.92	.85	.77	.72
Medium ports	.98	.96	.86	.80	.75

By long ports is meant those in which the length of port in inches divided by the area of the cylinder in square inches is approximately .12, and by short ports, where this ratio is about .05. If we assume .90 for the ratio in the case in hand, we shall have $200 \times .90 = 180$ lbs. at cut-off, which steam will weigh .432 lbs. per cu. ft. The volume of a cylinder 21 ins. diameter and 32 ins. long is 6.4 cu. ft., or for one revolution four times this amount or 25.6 cu. ft. No allowance is made for clearance, as the cut-off with lever in the corner is usually about 90 or 92 per cent. of stroke. For each revolution, then, the steam consumption will be.

$$25.6 \times .432 = 11.06 \text{ lbs.}$$

and

$$\frac{40{,}000}{60 \times 11.06} = 60 \text{ r. p. m.}$$

COAL CONSUMPTION OF LOCOMOTIVES.

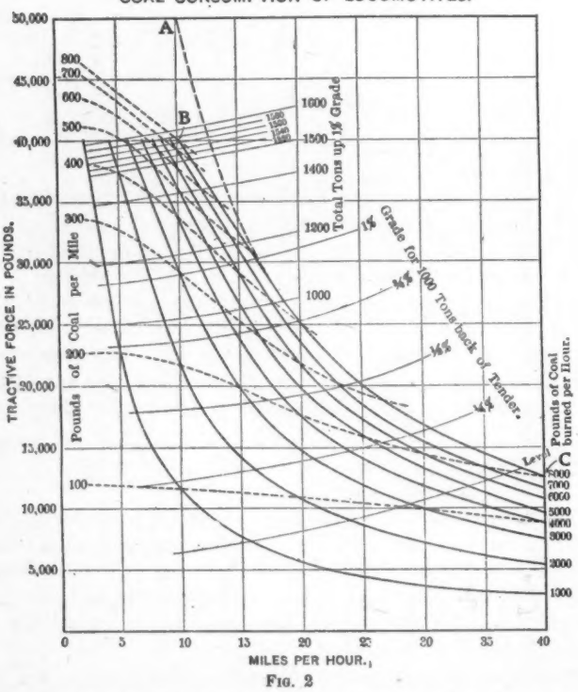


FIG. 2

as the maximum speed at which the boiler will furnish steam at full stroke. The speeds in miles per hour corresponding to the revolutions per minute for a 56-in. wheel are as follows:

5	10	15	20	25	30	35	40 miles per hour.
30	60	90	120	150	180	210	240 revs. per min.

therefore it is plain at above 10 miles an hour, the cut-off must be reduced, diminishing the available tractive force of the engine.

A study of the variation in tractive force due to speed indicates that the method explained below gives a close approximation to actual results.

In Fig. 2 the ordinates represent the tractive force in lbs., and the abscissae the speed in miles per hour. As the maximum speed at full stroke was found to be 60 r.p.m. or 10 miles an hour, we find the intersection of this speed with the theoretical tractive force at *A*. We therefore construct an equilateral hyperbola through this point, that is a curve the product of whose ordinates will always have the same value, viz., $50{,}000 \times 10 = 500{,}000$. As we have seen, the available tractive force, however, cannot exceed 40,000 lbs. By drawing from the point *B* a tangent to the hyperbola, we then have a locus consisting of a straight line and a curve, and this locus gives us the maximum available tractive force (at circumference of the drivers) for which the boiler will supply the cylinders at any speed. But to do this, we must burn 8,000 lbs. of coal an hour, so that the locus *BC* also gives the combinations of speed and available tractive force which may be obtained by the combustion of 8,000 lbs. of coal an hour.

The rate of combustion per sq. ft. of heating surface per hour is $\frac{8{,}000}{3{,}200} = 2.5$ and from Fig. 3 (curve *c*) we should expect 6 lbs. of water per lb. of coal from and at 212 deg.,

EVAPORATIVE VALUE OF COALS.

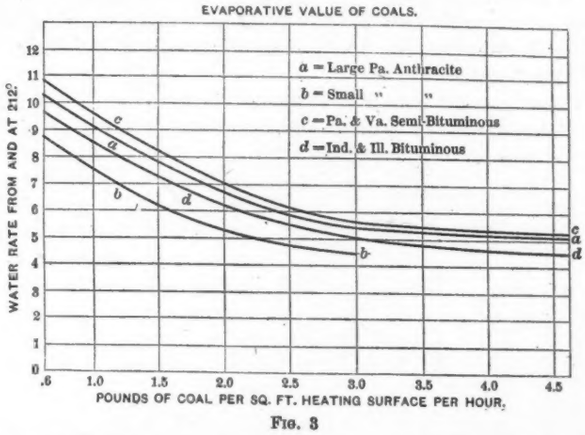

a = Large Pa. Anthracite
b = Small " "
c = Pa. & Va. Semi-Bituminous
d = Ind. & Ill. Bituminous
WATER RATE FROM AND AT 212°
POUNDS OF COAL PER SQ. FT. HEATING SURFACE PER HOUR.

FIG. 3

or a total steam production of $8{,}000 \times 6 = 48{,}000$ lbs., which is the same as our first figure. If the rate of combustion be reduced, however, there will be more steam generated per lb. of coal, as indicated by Fig. 3. For instance, if ¾ the amount be consumed, or 6,000 lbs., the rate of combustion will be $\frac{6{,}000}{3{,}200} = 1.87$ lbs. per sq. ft. of heating surface, and from Fig. 3 the evaporation will be about 7 or $7 \times 1.87 = 13.09$ lbs. of water per sq. ft. of heating surface per hour, instead of 15 lbs. as before. This would supply the cylinders at full stroke for 15 : 13.09 :: 10 : 8.7 miles an hour. From this, as a starting point, we construct a new hyperbola and tangent as before, which locus gives the combinations of speed and tractive force for 6,000 lbs. of coal an hour. In the figure, the loci have been drawn for each 1,000 lbs. per hour from 1,000 to 8,000.

If, now, we divide the quantities per hour by the speed, we obtain the fuel consumption per mile, and this is shown by the dotted lines. Thus, with a tractive force of 20,000 lbs. and a speed of 15 miles an hour, we should expect an hourly consumption of 3,000 lbs. or 200 lbs. per mile.

But as our diagram (Fig. 2) is based on speed and tractive force as co-ordinates, we can construct additional curves, which may represent the force needed to pull various trains at different speeds or up grades. For instance, if we consider a train of 1,000 tons weight back of tender, or 1,150 tons total weight, we can lay down the curves of resistance for a level, ¼, ½, ¾ and 1 per cent. grade, as shown in the diagram. By this means we can determine the quantity of coal that would be used on different portions of a division.

If there were 40 miles each of level, ½ and 1 per cent. grade, the fuel consumption would run as follows:

40 miles @ 38 miles an hour, 210 lbs. per mile =	8,400 lbs.
40 miles @ 24 miles an hour, 330 lbs. per mile =	13,200 lbs.
40 miles @ 17 miles an hour, 490 lbs. per mile =	19,600 lbs.
Total.....	41,200 lbs.

It will be noticed that this considers the train to be run at

the maximum speed which the engine can make on each grade or portion of track. If the speed be limited to 15 miles an hour uniformly, we should expect consumption as follows:

40 miles on level @ 50 lbs. per mile	=	2,000 lbs.
40 miles on ½% grade @ 190 lbs. per mile	=	7,600 lbs.
40 miles on 1% grade @ 430 lbs. per mile	=	17,000 lbs.
Total		26,800 lbs.

This trip of 120 miles will, however, require 8 hours for its completion, whereas the first schedule is a trifle over 5 hours. The coal consumption in the first case is over 50 per cent. greater than in the second case. The effect of speed upon the coal pile is clearly shown by following any of the grade lines in the diagram. The rate per mile on a ½ per cent. grade will be about as given below:

Miles per hour	5	10	15	20
Coal per mile, lbs.	150	160	185	250

The influence of loading is shown by the curves marked "Total tons up 1 per cent. grade."

At 10 miles an hour, 250 lbs. per mile for 1,000 tons.
At 10 miles an hour, 325 lbs. per mile for 1,200 tons.
At 10 miles an hour, 500 lbs. per mile for 1,400 tons.

When we near the limit of capacity of the engine, the difference is still more marked.

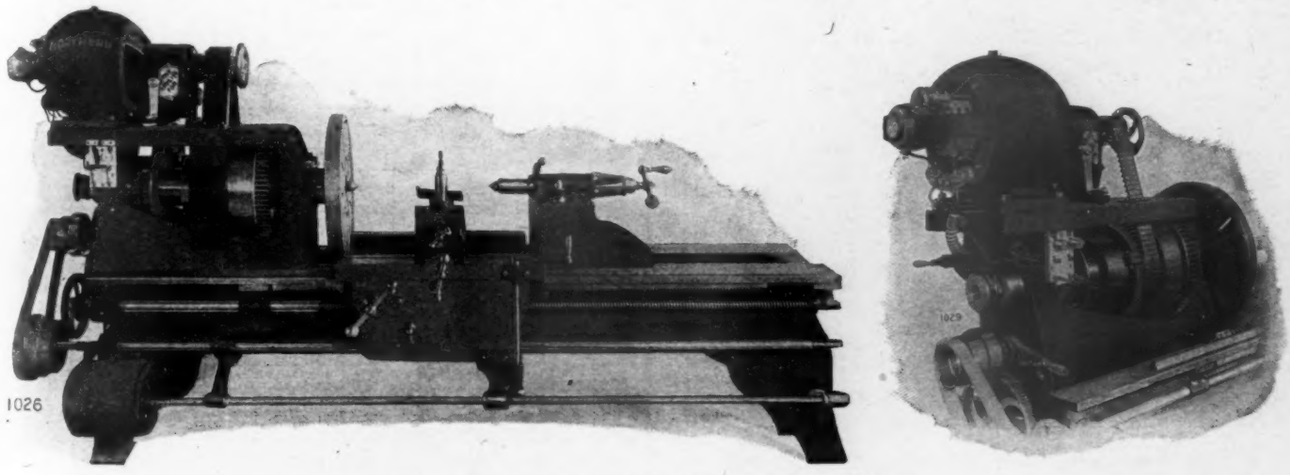
At 10 miles an hour, 630 lbs. per mile for 1,500 tons.
At 10 miles an hour, 680 lbs. per mile for 1,520 tons.
At 10 miles an hour, 720 lbs. per mile for 1,540 tons.
At 10 miles an hour, 780 lbs. per mile for 1,560 tons.

Again, 1,600 tons can be hauled at 5 miles an hour with a consumption of 500 lbs. per mile, whereas 1,570 tons at 10 miles an hour will require 800 lbs. per mile, both cases being the maximum that the engine can do.

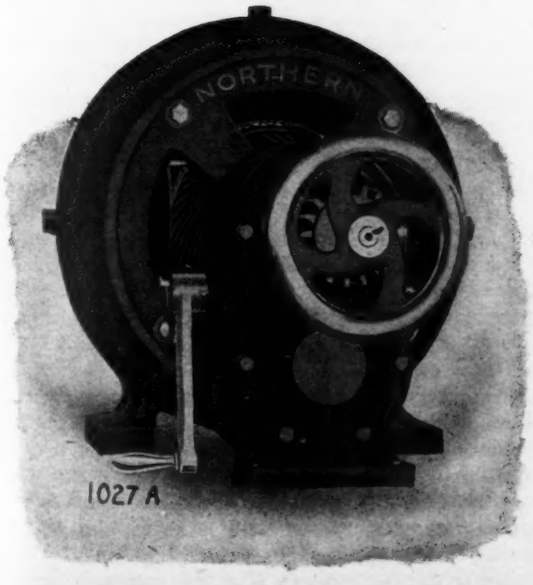
These examples give an idea of the variety of problems in fuel consumption which can be quickly solved by the aid of this diagram. It is true that a different diagram must be made for each class of engine, but this is a comparatively small matter. With the increase in speed and loads of the present day, the coal consumption becomes a topic of great interest, and when comparisons are made with previous schedules, there is an apparent decrease in the economy of fuel, unless the various points are duly considered, and as explained by the chart.

MUTI-SPEED MOTOR.

The problem of equipping old machine tools with variable speed motors, and furnishing such machines as lathes with a sufficiently wide range of speed, has been complicated because of the additional mechanical speed changes required to supplement the electrical speed variations. The expense and the amount of work required to do this properly are such that many are discouraged from applying motors to belt-driven tools, much as they might wish to avail themselves of the benefits to be derived from such a change. A multi-speed motor has just been placed on the market by the Northern Electrical Manufacturing Company, which consists of a variable speed field control motor with a mechanical change gear device attached to and forming part of it, as shown in the illustrations. By this means a speed variation of 4½ to 1 can



NORTHERN MULTI-SPEED MOTOR APPLIED TO BLAISDELL LATHE.



NORTHERN MULTI-SPEED MOTOR.

be obtained by the use of a 2 to 1 motor, or with a 3 to 1 motor a total speed range of 9 to 1 can be obtained. The change gears are run in oil and are noiseless.

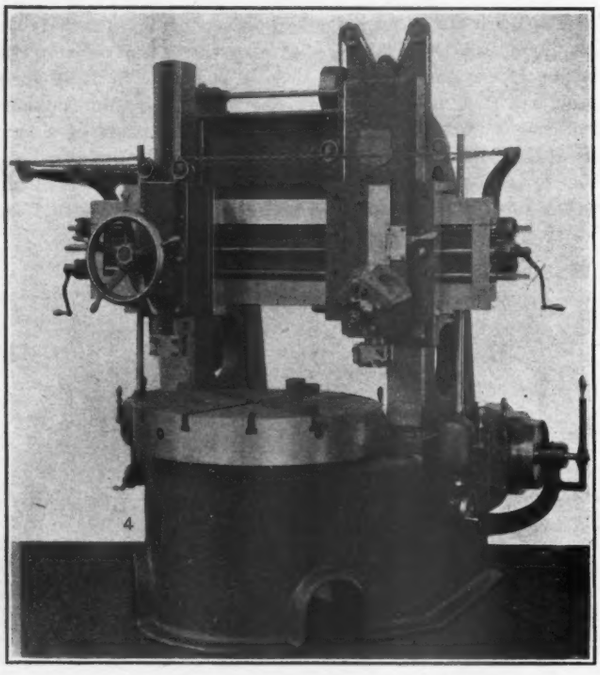
Probably no class of machine tools is more difficult to change from the belt to a motor drive than the ordinary engine lathe. As the speed range of a variable speed motor is considerably less than the back gear ratio of a belt-driven lathe, it becomes necessary, in order to avoid a large gap between the two runs of gearing, to change the back gear ratio, and this introduces a number of complications. These difficulties disappear with the introduction of the multi-speed motor, as will be noted by a study of the application of one of these motors to a 24-in. Blaisdell lathe shown in the accompanying illustrations. The spindle bearing caps were simply removed and a cast iron bracket which supports the motor was substituted in their place. The motor in connection with the change gears had a sufficient speed variation so that it was not necessary to change the back gear ratio. The motor was connected by a silent chain to the split sprocket clamped on one of the steps of the cone pulley. The motor controller was bolted to the lathe bed and is operated through the spline shaft and the lever on the carriage.

The controller furnishes 20 speeds, and thus by means of the controller handle and the change gear lever 40 speeds may

readily be obtained without stopping the machine. The use of the back gear on the lathe doubles this number and gives the lathe a very wide range of speed. The machine can be stopped for examination or measurement of work without stopping the motor and quickly started again by the clutch lever on the change gear device. With a 5 to 1 motor a speed variation of 15 to 1 can be obtained.

42-IN. BORING MILL.

A powerful and conveniently operated boring mill is shown in the engraving. By means of the turret head with five sides, at the right, the output of the machine can be materially increased on certain classes of work. The 3-jaw universal chuck is built into the table, which is 40 ins. in diameter. Power is transmitted from a cone pulley to the table through two frictions and a back gear, giving four changes of table speed for each step of the cone. These mechanical changes can be made instantly, while the machine is in motion.



42-IN. BORING MILL.—KING MACHINE TOOL COMPANY.

A motor may be readily applied by gearing direct to the driving mechanism, and without the use of brackets. With a constant speed motor 12 table speeds may be obtained. The table is driven by accurately planed bevel gears.

Eight positive horizontal and vertical feeds, varying from 1-40 to ½ in., are provided. The heads are independent in their movements, both as to direction and amount of feed By means of friction clutches the rail may be quickly and noislessly raised or lowered by power. This machine is made by the King Machine Tool Company of Cincinnati, Ohio, and weighs about 12,000 lbs.

GAS TURBINES.—From an elaborate paper read by Mr. R. M. Neilson before the Institution of Mechanical Engineers in London, October 21, the following impressions are received. First—The gas turbine seems at present a mechanical impossibility although the difficulties may perhaps be overcome. Second—The temperatures necessary to be used are sufficiently high to heat the blades of the turbine to a bright red heat, which would soon burn them up. Third—Compressors need to be greatly improved in efficiency for this work or the power required for compression will be practically equal to that delivered from the turbine. This is a discouraging outlook, but many minds are at work, at home and abroad, upon the problem.

TWIST DRILL TESTS.

The following results of tests made with twist drills are taken from a paper on "A Twist Drill Dynamometer," presented before the December meeting of the American Society of Mechanical Engineers by Messrs. W. W. Bird and H. P. Fairchild. The tests were conducted at the Washburn shops of the Worcester Polytechnic Institute, on a machine which measured and registered both the twisting moment and the thrust of the drill.

Blocks of soft gray iron were obtained and tested in the machine itself, so as to get a number for each set of experiments as near the same degree of hardness as possible. A ⅝-in. Novo steel drill was used. The first experiments were on the effect of speed or number of revolutions per minute,

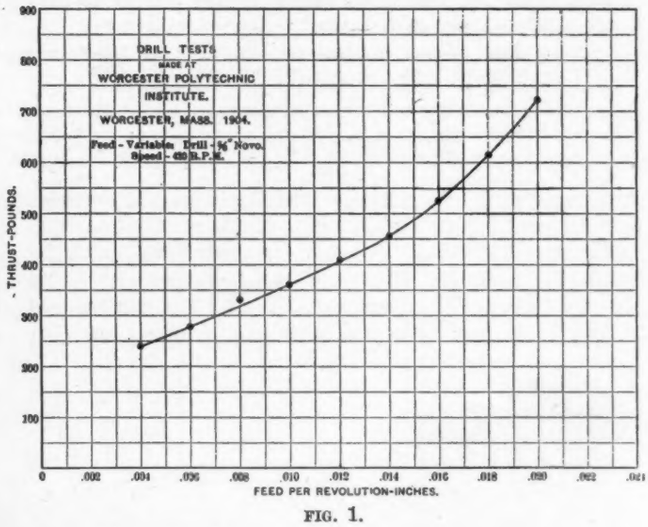


FIG. 1.

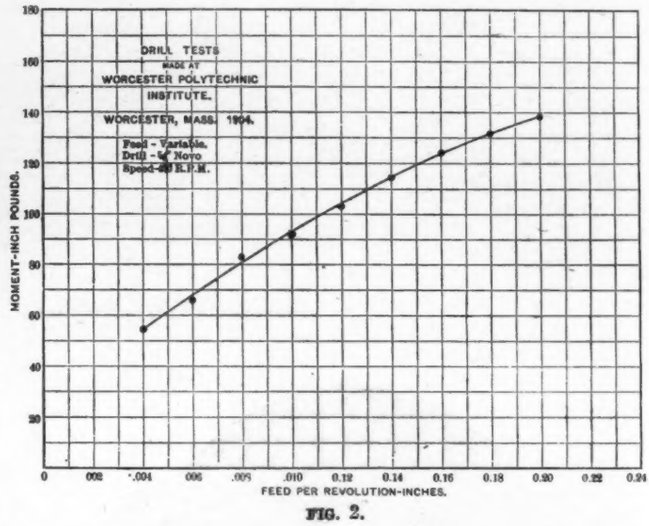


FIG. 2.

all other conditions remaining the same. The revolutions were varied from 140 to 600, but no material difference was shown by the cards in either thrust or twist. In other words, the power required to turn the drill varies directly with the number of revolutions, while the thrust does not increase with the speed, but depends upon the feed or the advance per revolution.

The next set of experiments was made to determine the relation between thrust and feed, the revolutions per minute remaining constant. From the first set of experiments it was shown that the limit of speed would depend upon the endurance of the drill, and with heavy feeds 420 revolutions was not far from this limit. Accordingly, the second set was run at this speed, which for a ⅝-in. drill is about 70 ft. per minute for the cutting rate for the outer edges, and for .020-in feed a rate of drilling of about 8 ins. per minute. The range of feed was taken from .004 to .020 ins. per revolution, the

drill at the coarsest feed being somewhere near its limit. These feeds were all positive, a train of gears being substituted for the regular belt drive. The results are plotted in Fig. 1, and show that the thrust increases very rapidly with the coarser feeds.

Fig. 2 is a curve, giving the relation between moment and feed, and shows that the moment does not increase at the same rate as the thrust. This would seem to indicate that less power is required to drill a given hole in a given time by increasing the feed per revolution rather than by increasing the revolutions. For example, to drill a hole in a 1-in. plate in 10 seconds could be done by running the drill 600 r.p.m., and feeding .010 ins. per revolution, but would require more power than by running at 300 revolutions with a feed of .020 ins.

The question of the proper angle of the drill was next considered, and a set of experiments made with a constant speed and feed, the half-angle varying from 37 deg. to 70 deg., 22 deg. less and 11 deg. more than the standard, 59 deg.

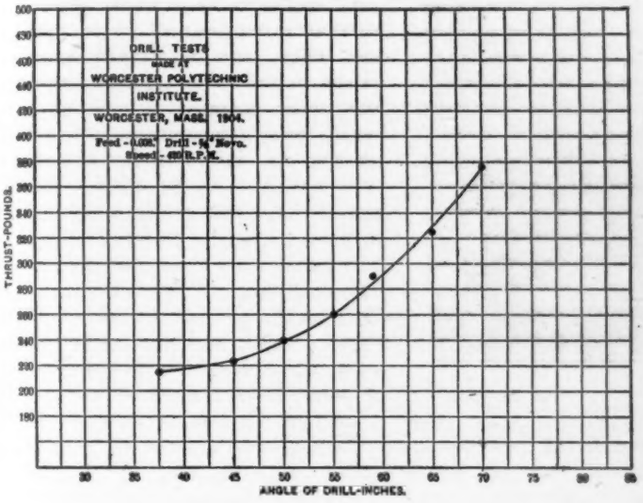


FIG. 3.

The results are plotted in Fig. 3, and show that the thrust would be decreased by having more of a point on the drill. With an angle of 37 deg., however, the drill would not stand up on repeated work. At 45 deg. it seems to do the work as well as at 59 deg., and with much less thrust. This would suggest a change in the standard angle for the new steels. The moment for the various angles remained practically constant, so that the driving power does not change with the angles of the drill. Another interesting point in drilling, which can be shown with this machine, is the effect of first removing the center of the hole by the use of a small drill. Ten holes were drilled in a bar of cast iron with small drills, ranging from No. 53 to ½ in. in diameter, and then each one counterbored with a ⅝-in. drill at 420 r.p.m. and a feed of .008 in. per revolution. The following table gives the thrust in each case, and shows that a hole 1-10 in. in diameter takes off about one-half the thrust for a ⅝-in. drill.

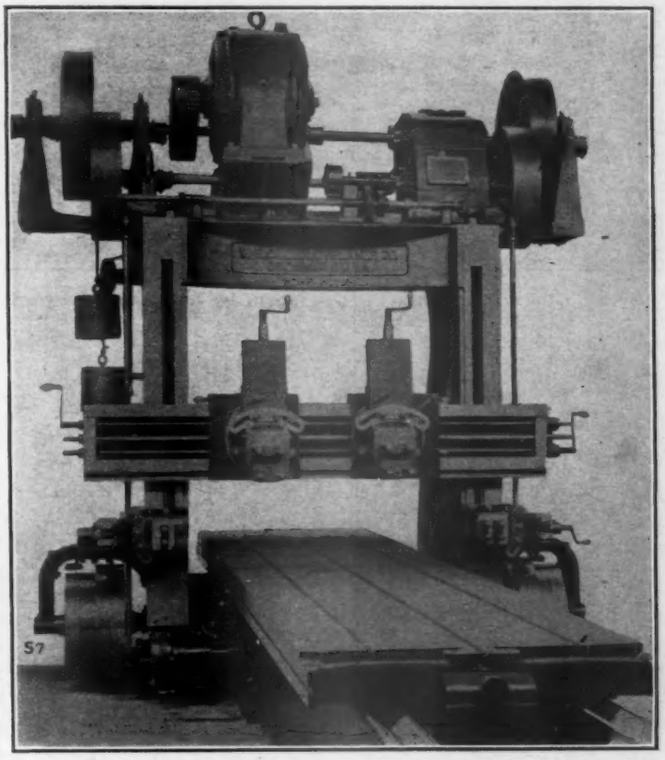
Size of first hole—										
.000	.0595	.0760	.0935	.120	.157	.189	.221	.250	.375	.50
Thrust for counterbore—										
240	190	180	170	155	145	130	120	90	70	30

ECONOMY OF ELECTRIC TRACTION.—The saving in coal with a central station electric power plant over steam locomotives is greater than is often assumed. The plant of the Manhattan Elevated delivers power to the switchboard at the rate of 2.6 lbs. of coal per k.w.-hour under conditions of full load, and the power is delivered to the motors through the third rail with about 60 per cent. efficiency, giving a consumption of 4.3 lbs. per k.w. or 3 lbs. per h.p. at the drawbar. A road with heavy traffic and a large and efficient central power station should use only about half as much coal as when using steam locomotives, and this may even be reduced under favorable conditions to one-third.—*L. B. Stillwell, before International Engineering Congress.*

NEW PLANER DRIVE.

The photograph illustrates a planer arranged for 6 different cutting speeds with a constant return speed and driven by a constant high speed motor. This has two advantages over the variable speed motor drive; the power is not reduced at slow speeds, and the return speed is constant and does not vary with the cutting speed. Power is transmitted from the motor to the shaft which carries the pulleys for the return stroke by a Morse silent chain. Motion is in turn transmitted through a speed box to a shaft which carries the pulleys which drive the platen on the cutting stroke. The speed box contains 2 trains of gearing, each of which will give three different speeds to the platen. The speeds are changed by means of levers at the side of the planer which can be operated either while the machine is in motion or standing idle. The gears in the speed box are steel and run in oil, thus reducing wear and noise to a minimum. The entire box is inclosed and holds about 5 gallons of oil.

Owing to the high cutting speed at which the planer operates, a double driving mechanism is used. A complete set of



CINCINNATI PLANER WITH IMPROVED DRIVE.

driving pulleys for both the forward and return motion of the platen are attached on each side of the machine, thus doubling the belt capacity and still retaining the ease of shifting, which would be impossible if 1 belt 7 ins. wide was used in place of 2 belts 3½ ins. wide. All the pulleys on the top shafts are made with a heavy rim, thus acting as flywheels and relieving the motor when the platen is reversing in either direction.

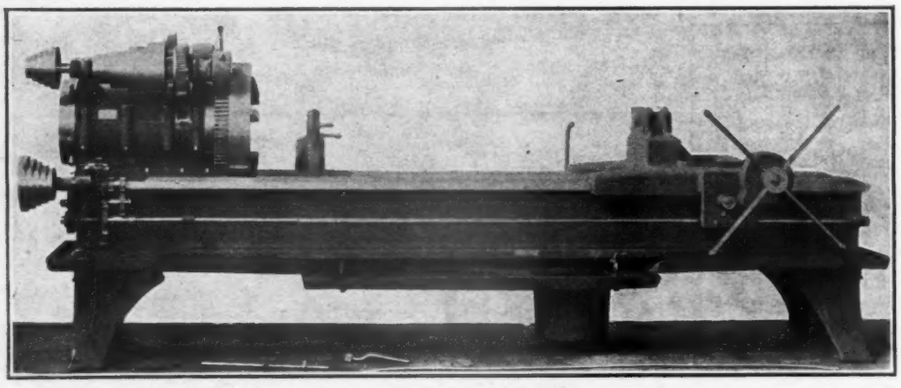
The cutting speeds furnished are 22, 27, 32, 40, 50 and 60 ft. per minute, with a constant return of 75 ft. per minute. An index plate placed on the side of the housing indicates the cutting speed in use. The planer is driven by a 30-h.p. Westinghouse alternating 3-phase motor. The machine will plane work 66 ins. wide, 60 ins. high and up to 21 ft. in length. It is fitted throughout with steel gearing and was built by the Cincinnati Planer Company, Cincinnati, who are in position to put a similar speed variator on all sizes of their machines.

It does not matter what the cost of your repairs is, but it does matter whether the cost is going up or down.

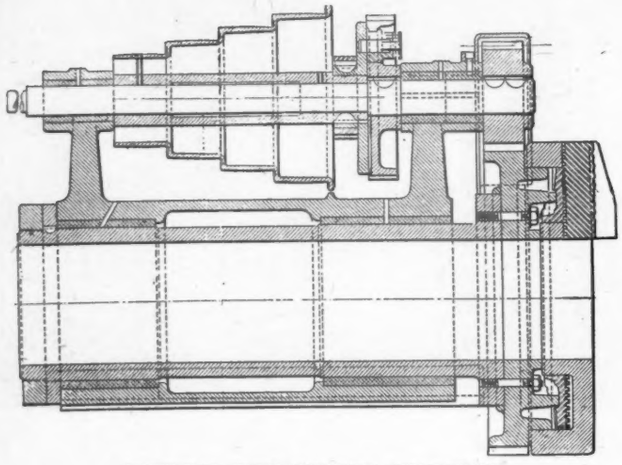
AXLE BORING MACHINE.

The Pennsylvania Railroad makes a practice of boring a 2-in. hole longitudinally through all driving axles above a certain size, to guard against defective material and defects in forging not found in smaller axles, where the material can be more thoroughly worked. This is done at a relatively small cost by the Springfield axle boring machine, shown in the photograph, and specially designed for this purpose.

This machine will bore holes from ¾ in. to 6 ins. in diameter through stock up to 11 ins. in diameter and 84 ins. in length. The bar to be bored is held by a three-jaw universal scroll chuck, secured to a flange cast on the front of the spindle, and is supported and held central at the other end of the spindle by adjustable screws. The spindle consists of a cast iron shell, as shown in the sectional view, and has long bearings in the headstock. A large gear cut into the rear of the



SPRINGFIELD SPINDLE AND AXLE BORING MACHINE.



SECTIONAL VIEW THROUGH HEADSTOCK.

chuck on the spindle engages with a pinion on the auxiliary shaft, upon which the four-step driving cone is mounted. By means of the back gears and a two-speed countershaft 16 spindle speeds are furnished in geometrical progression.

The center of the headstock is placed as low as possible, and the long carriage which carries the boring tool is moved by pinions, which mesh into two racks, one on each side of the top of the bed. This makes a very powerful arrangement, and reduces the stresses on these parts to a minimum. The carriage slides on two large V's, and is gibbed its full length to the outside of the bed. Ten feeds are provided from .0005 in. to .01 in. per revolution. The power feed is engaged by a powerful friction clutch.

By means of the large pilot wheel, the carriage can rapidly be moved to any position. The guide for centering the boring tool is used only for starting the tool, after which it may be swung out of the way. The cutting edges of the tool are lubricated, and the chips are washed out, by oil supplied by a force pump. The pan which surrounds the machine has a large capacity, and the lubricant has sufficient time to cool before being used again. This machine weighs 7,000 pounds, and is the larger of two sizes made by the Springfield Machine Tool Company, of Springfield, Ohio.

HIGH SPEED TOOL STEEL.

(CONCLUDED FROM VOL. 78, PAGE 48.)

For hardening and tempering specially formed tools of high speed steel, such as milling and gear cutters, twist drills, taps, screwing dies, reamers, and other tools that do not permit of being ground to shape after hardening, and where any melting or fusing of the cutting edges must be prevented, another method of hardening is used. A specially arranged muffle furnace heated either by gas or oil is employed, and consists of two chambers lined with fire clay, the gas and air entering through a series of burners at the back of the furnace, under control so that a temperature up to 2,200 deg. Fahr. may be steadily maintained in the lower chamber, while the upper chamber is kept at a much lower temperature. Before placing the cutters in the furnace it is advisable to fill up the hole and keyways with common fire clay to protect them. The cutters are first placed upon the top of the furnace until they are warmed through, after which they are placed in the upper chamber and thoroughly and uniformly heated to a temperature of about 1,500 deg. Fahr., or, say, a medium red heat, when they are transferred into the lower chamber and allowed to remain therein until the cutter attains the same heat as the furnace itself, about 2,200 deg. Fahr., and the cutting edges become a bright yellow heat, having an appearance of a glazed or greasy surface. The cutter should then be withdrawn while the edges are sharp and uninjured, and revolved before an air blast until the red heat has passed away, and then while the cutter is still warm—that is, just permitting of its being handled—it should be plunged into a bath of tallow at about 200 deg. Fahr., and the temperature of the tallow bath then raised to about 520 deg. Fahr., on the attainment of which the cutter should be immediately withdrawn and plunged in cold oil. There are various other ways of tempering, a good method being by means of a specially arranged gas and air stove into which the articles to be tempered are placed, and the stove then heated up to a temperature of from 500 to 600 deg. Fahr., when the gas is shut off and the furnace with its contents allowed to slowly cool down. Another method of heating tools is by electrical means, by which very regular and rapid heating is obtained, and where electric current is available, the system of electric heating is quick, reliable and economical.

Electricity also furnishes a very efficient and accurate means of tempering such forms of tools as milling, gear, hobbing and other similar cutters, also large hollow taps, hollow reamers, and all other hollow tools made of high speed steel, where it is required to have the outside or cutting portion hard, and the interior soft and tenacious, so as to be in the best condition to resist the great stresses put upon the tool by the resistance of the metal being cut, and which stresses tend to cause disruption of the cutter if the hardening extends too deep.

Tempering of hollow cutters, etc., is sometimes carried out by the insertion of a heated rod within the cutter and so drawing the temper, but this is not entirely satisfactory, or scientific, and is liable to induce cracking by too sudden heat application, and further because of the difficulty of maintaining the necessary heat and temperature required, and afterward gradually lowering the heat until the proper degree of temper

has been obtained. In electrical tempering these difficulties are overcome, as the rod is placed inside the cutter quite cold, and the electric current gradually and steadily heats up the rod until the correct temperature is reached, when it can be held at such temperature as long as is necessary, and the current can be gradually reduced until the articles operated on are cold again, and consequently the risk of cracking by too sudden expansion and contraction is reduced very greatly.

That great economy is effected from using high speed steel is beyond all doubt, for rapidity of cutting is increased, and the output of machines correspondingly, so that a greater production is obtained from a given installation than was possible when cutting at low speeds with the old tool steel, and the work is naturally produced at a correspondingly lower cost. It follows from this that in laying down new plant and machines the introduction and use of high speed steel would have considerable influence in reducing expenditure on capital account. It has also been proved that high speed cutting is economical from a mechanical standpoint, and that a given horse-power will remove a greater quantity of metal at a high speed than at a low speed, for although more power is naturally required to take off metal at a high than at a low speed, the increase of that power is by no means in proportion to the large extra amount of work done by the high speed cutting, for the frictional and other losses do not increase in the same ratio that a high cutting speed bears to a low cutting speed. A brief example of this may be given in which the power absorbed in the lathe was accurately measured electrically. Cutting on hard steel, with 3-16 in. depth of cut, 1-16 in. feed and speed of cutting 17 ft. per minute, a power of 5-16 h.p. was absorbed, and increasing the cutting speed to 42 ft. per minute, the depth of cut and feed being the same, there was a saving in power of 19 per cent. for the work being done. Another experiment with depth of cut ⅜ in. and traverse 1-16 in. compared with 1-16 in. traverse and 3-16 in. depth of cut, showed a saving in power of as much as 28 per cent., and still proceeding with a view of increasing the weight of metal removed in a given time the feed was doubled (other conditions being the same) and a still further saving of power resulted. In a word, as in the majority of things, so it is with rapid cutting, the more quickly work can be produced the cheaper the cost of production will be.

Again as regards economy there is not only a saving effected on the actual machine work, but since the advent of high speed cutting it is now possible, in many instances, to produce finished articles from plain rolled bars, instead of following the old practice of first making expensive forgings and afterward finishing them on the machine. By this practice not only is the entire cost of forging abolished, but the machining on the rolled bar can be carried out much quicker and cheaper in suitably arranged machines, quicker even than the machining of a forging can be done. Remarkable results are also obtained by operating on stock bars with high speed milling cutters.

Rapid cutting with planing tools has also developed extensively, the old cutting speeds of 15 to 25 ft. per minute being now replaced by those of 50 to 60 ft. per minute, and in some cases even as high as 80 ft. per minute, and for the same reasons, as already described in lathe turning, the power absorbed does not increase in anything like the same proportion as the extra amount of work done, so that the wear and tear on the machine is not materially increased.

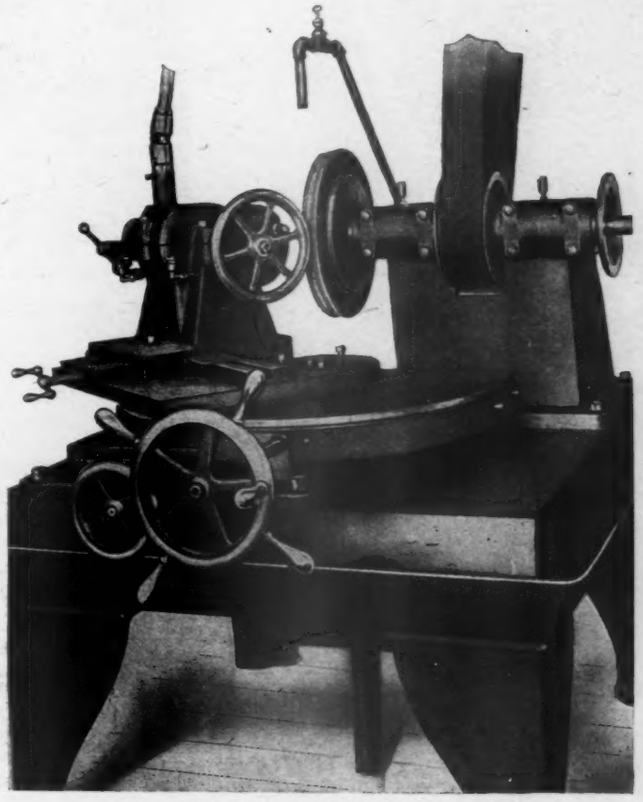
Perhaps one of the most unlooked-for developments in the use of high speed steel has been the manufacture from it of twist drills, and it would be safe to say that in no other sphere has the new steel justified itself to a greater extent than in the operations of drilling and boring, as its powers in that respect have revolutionized completely modern workshop practice. It is now possible in many cases to drill holes through stacks of thin steel plates as quickly and economically as by punching them, thus avoiding the consequent liability to distress the material due to punching action.

As a comparison of the superiority of high speed over ordinary drills, an instructive result was obtained when drilling forged steel gun cradles of 5 ins. thickness, and which steel is of a very tough nature. An ordinary twist drill was first tried and failed after drilling 8 holes, the end being completely fused, but a high speed drill afterward drilled 124 holes without suffering any injury whatever. The drills were 2 ins. diameter, running at 80 revolutions per minute, and each hole was drilled in 6 minutes, this being the full power of the machine. In several instances the author's firm reduced the cost of drilling per 100 holes by over 60 per cent. without even altering the machines in any way, except by speeding them up.

HAND WHEEL GRINDING MACHINE.

The hand wheel grinding machine shown in the accompanying illustration finishes the outer rim of a hand wheel from the rough, ready for the buffer at one operation, without machining it with a tool. A certain hand wheel which required 1 hour to finish by the machining process was finished in 9 minutes on this grinding machine.

The bed, a planed casting 43 by 41 ins. is mounted on a cast iron pan on legs. The grinder head is bolted on the back of the bed. At the front is a dove-tailed slide having 17½ ins. of bearing for the swivel slide. The swivel slide has a cross-feed of 13 ins. to and from the grinder, and upon it is mounted

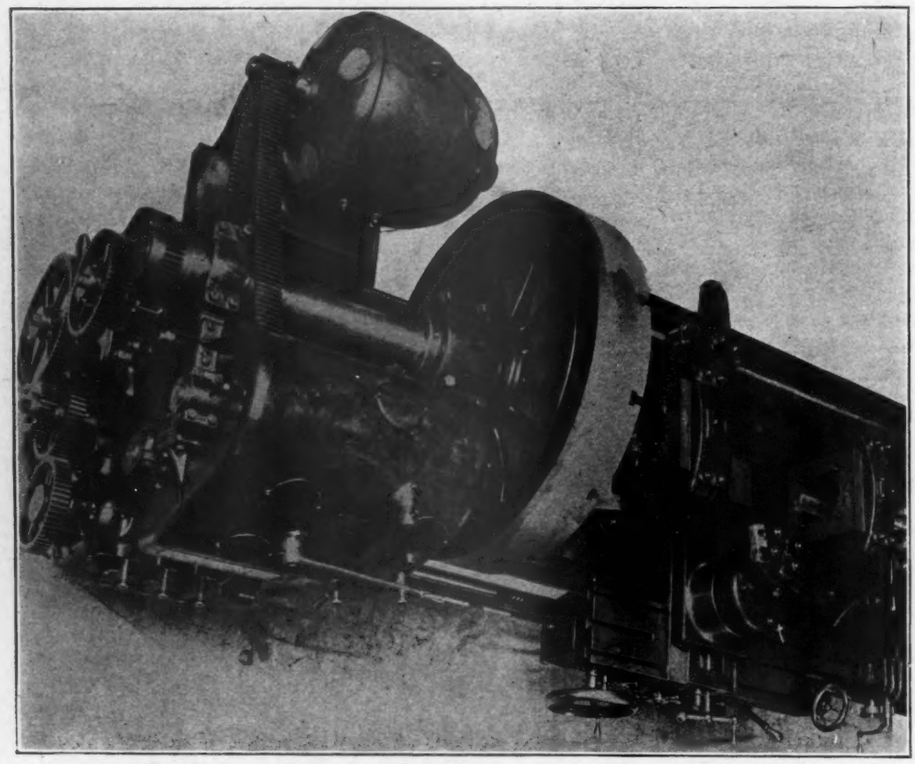


HAND WHEEL GRINDING MACHINE—LODGE & SHIPLEY MACHINE TOOL COMPANY.

a second slide with its center fixed upon the swivel slide in line with the grinding wheel, so as to center all diameters. The pilot wheel at the front provides a rotary movement about the grinder. A cross adjustment is provided for the head-block carrying the hand wheel to be ground, and the spindle holding the hand wheel is also adjustable, so as to bring different diameters of hand wheels directly over the swivel center. The speed of the hand wheel to be ground is controlled through a universal joint driven from a variable speed countershaft. The Lodge & Shipley Machine Tool Company of Cincinnati are the manufacturers of this machine.

60-INCH MOTOR-DRIVEN ROLL-TURNING LATHE.

This lathe was designed for turning heavy pipe rolls, etc., and is made very substantial throughout to withstand the severe strains which come upon it in connection with this class of work. A Crocker-Wheeler Co. 25 h.p. variable speed motor is mounted on a cast iron stand attached to the bed at the rear of the headstock and is connected to the driving shaft by silent chain, as shown. Releasing the small knobs in either of the handles on the front of the headstock hood allows them to be thrown to the right or left, thus operating the clutches which control the different runs of gearing in the headstock. These speed changes, in addition to those furnished by the motor, afford a wide range of speed with a large number of steps. An index plate, prominently placed, indicates the proper combination to be used for any desired spindle speed. The motor controller is place alongside the motor stand and is operated by the hand wheel at the right hand end of the carriage.

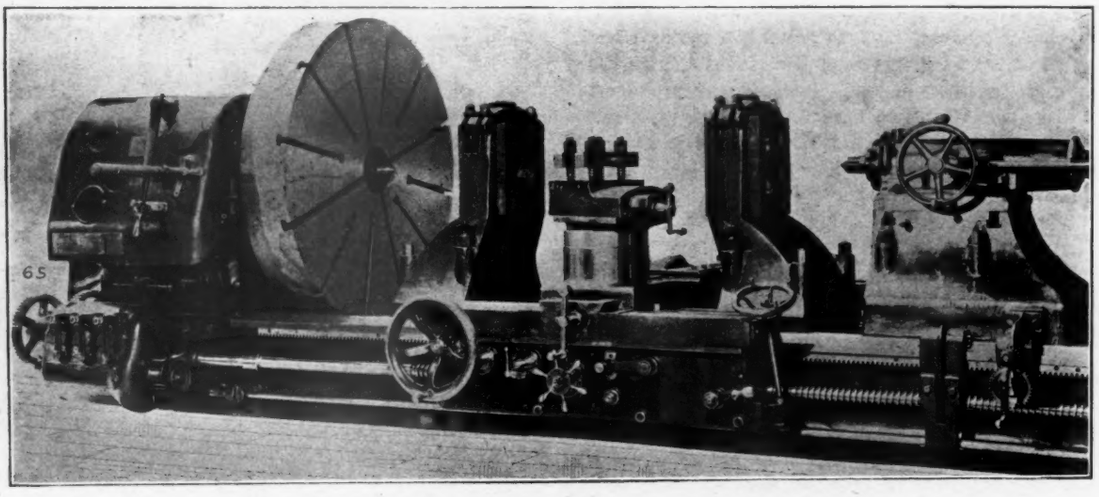


VIEW LOOKING DOWN ON 60-INCH ROLL-TURNING LATHE.

Near the end of the bed, below the headstock, is the feed changing device, and by means of the three levers, which are shown, seven distinct and positive feeds can be obtained without removing a single gear. The feed gears are neatly housed in, and an index plate indicates the combination to be used for any pitch, thread or feed.

What appears to be a taper attachment will be noted in the view looking down on the lathe. It is used to impart curved surfaces to long pipe-straightening rolls and is operated by a shoe provided with anti-friction rollers which slide in a slot. Straight work can be turned by disengaging the nut which holds the shoe and by tightening the cross feed nut. The concaving rest shown in the same view is interchangeable with the compound rest, and is used for grooving out pipe welding rolls. It operates with rotary motion through worm and worm wheel, with either hand or power feed.

The heavy housings shown are for holding heavy pipe roll castings. This lathe is built by the American Tool Works Co., of Cincinnati.



60-INCH ROLL-TURNING LATHE—AMERICAN TOOL WORKS COMPANY.

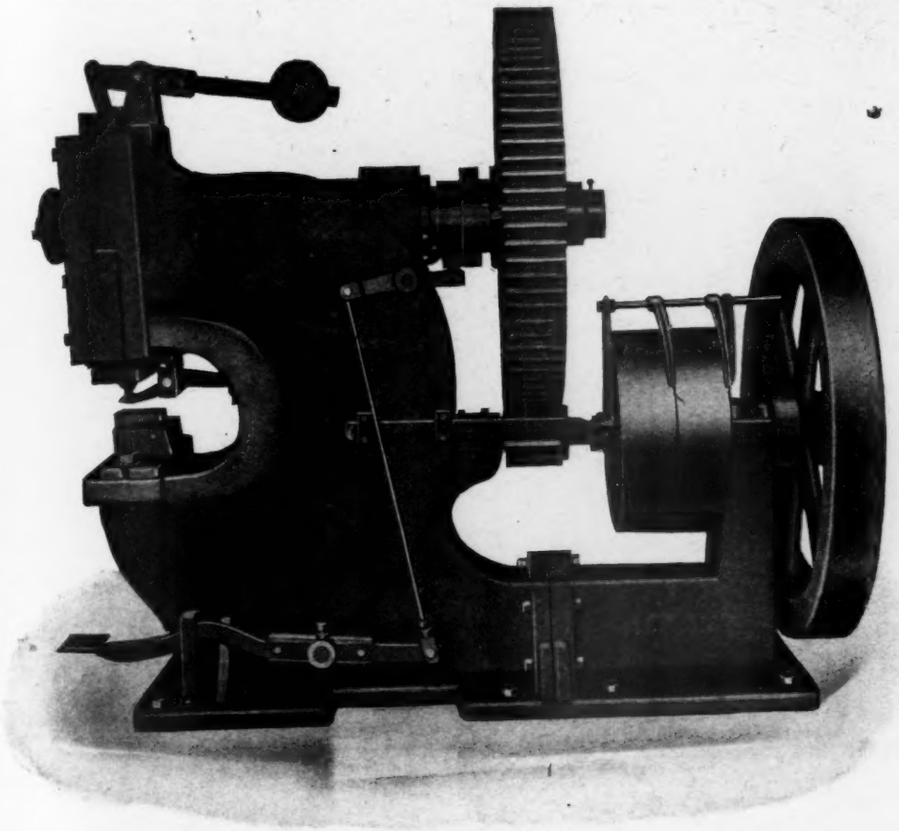
SPEED OF STEAM TURBINES.—High speed of rotation has been a rather serious drawback to the steam turbine as applied to marine practice. This has been overcome in designing the machinery for the new Cunarders, the turbines of which are expected to run at about 140 r.p.m. This appears to be an important feature of present development of the turbine for marine service.

CONTRIBUTIONS TO THE PURDUE MUSEUM.—The New York, New Haven & Hartford Railway, through the courtesy of Mr. Samuel Higgins, general manager, has arranged to place in the care of Purdue University the historic locomotive, "Daniel Nason." This locomotive was built about 1858, and is one of the 8-wheel type, with cylinders inside the frames and cranked axles, which were common throughout New England 30 years ago. They are also placing in their keeping a stage coach passenger car which was put in service about 1835, and consists of the body of a stage coach suspended over a simple railway truck by means of braces.

IMPROVED PUNCHING MACHINE.

The photograph and drawing illustrate a new positive adjustable stop as used in connection with an improved sliding clutch on a Cincinnati punch. By means of the adjustable stop the machine can be made to stop at either the top or bottom of the stroke or at any intermediate point. This is of special advantage for such work as exact center punching, as considerable time can be saved by having the punching tool automatically stop close to the work.

The mechanism which controls this is simple and consists of a brass cam fastened in the groove of the clutch and held in place by a bolt whose head fits in the deep slot to the left of the groove in which the clutch lever lug works. By loosening the nut on the bolt the cam can be set at any desired point on the circumference. As the cam comes in contact with the lug on the clutch lever, the clutch is thrown out and the machine is stopped. This makes a very simple and positive device.



CINCINNATI PUNCH, WITH POSITIVE ADJUSTABLE STOP AND IMPROVED SLIDING CLUTCH.

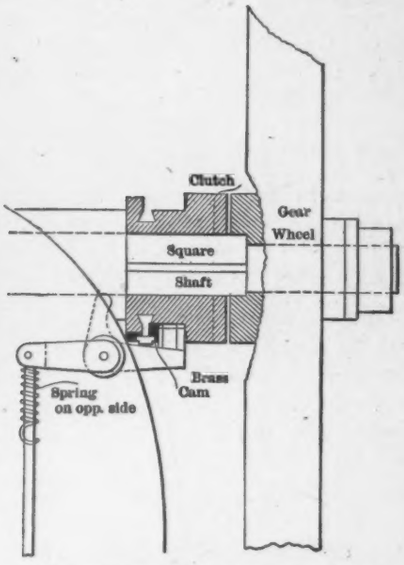
The section of the driving shaft upon which the clutch slides is square, with the distance across the flats equal to the diameter of the round portion of the shaft. This obviates the use of keys or feathers which, because of the heavy intermittent stresses to which the shaft is subjected, are a source of annoyance, and it also greatly increases the strength of the shaft at what is ordinarily its weakest point. These devices are used on the punches and shears made by the Cincinnati Punch & Shear Company.

ENGLISH RAILWAY EQUIPMENT.—The railways of the United Kingdom at the close of last year owned 22,276 locomotives and 801,926 passenger carriages, wagons and other vehicles. In the total for England are included the following stock for lines worked by electricity, viz., 96 locomotives, 642 carriages and 19 other vehicles; and for Ireland the following stock for light railways, viz., 47 locomotives, 134 carriages and other vehicles attached to passenger trains, 497 wagons and 20 other vehicles.

A NEW FRANKLIN AIR COMPRESSOR.

The accompanying illustration shows one of the air compressors recently furnished the Pennsylvania Railroad at Altoona, Pa. They were designed and built by the Chicago Pneumatic Tool Company at Franklin, Pa., and belong to what they designate as their "C. S. C." class of machines, having compound steam cylinders and compound air cylinders. They are designed to run non-condensing with a boiler pressure of 100 lbs. The high and low pressure steam cylinders are 11 and 20 ins. in diameter respectively, and air cylinders 11 and 18 ins., with a stroke of 24 ins. The capacity of each compressor is 700 cu. ft. of free air at a speed of 100 r.p.m.

While graceful in outline, the machine is at the same time massive and compact. All bearings are of unusually generous proportions, the pressure per sq. in. being so reduced as to avoid any tendency to heating, a feature which will be appreciated by those who have had much experience with air compressors. The bearings throughout are provided with removable shells or bronze bushings, with simple but effective provision for taking up wear. The steam cylinders are provided with Meyer adjustable cut-off valves. The main steam valves are double ported, admitting of short ports and consequent reduction of clearance. The high and low pressure main steam valves are efficiently balanced, reducing friction and wear to a minimum. Both air cylinders are provided with mechanically operated inlet valves of the Corliss type, which are placed in the cylinder heads, admitting of close clearance and large port area, with consequent free admission of air. These valves are actuated by the steam cut-off eccentrics, so that four eccentrics drive both steam and air valves, the valve gear being very simple for the work performed. The discharge valves are of the poppet type, being of cup shape, pressed out of sheet steel. The valve seats and guides are removable, and readily accessible for inspection or renewal.



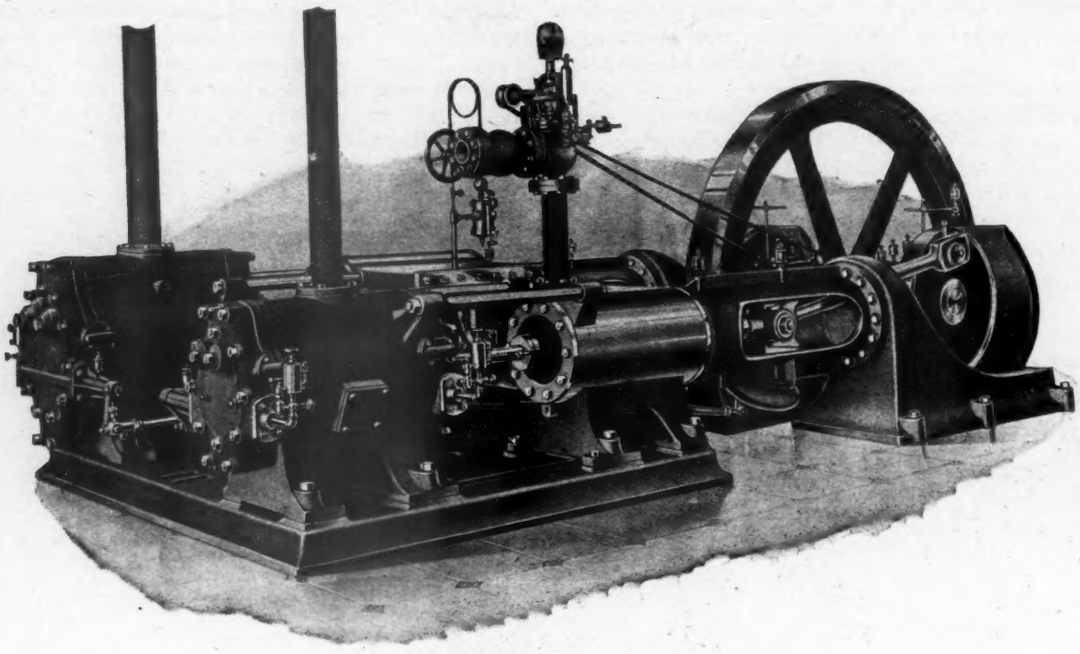
ADJUSTABLE STOP AND SLIDING CLUTCH ON CINCINNATI PUNCH.

An intercooler, not shown, is provided between high and low pressure air cylinders, which cools air after compression in the low pressure cylinder down to the temperature of the atmosphere. This intercooler, being self-contained, may be placed in any location desired. Owing to small bore of the cylinders and proportionately long stroke, the percentage of clearance in the air and steam cylinders is very small, resulting in high efficiency and economizing of steam. The water jacketing also is much more effective than in the compressors

of ordinary proportions, having diameters of cylinders about the same as length of stroke. Provision is made for catching all drip from stuffing boxes and bearings.

The governor is furnished with a pressure regulator, which brings the machine to a stop when the receiver pressure has reached a desired amount, starting it again automatically upon a slight drop in receiver pressure. The governor is also supplied with a safety stop, which will prevent the compressor from running away in case of accident to the governor belt. A rigid box section bed plate extends under the four cylinders to which they are securely doweled, a feature which is a great help in setting the machine and maintaining its alignment.

Further information may be obtained from the Chicago Pneumatic Tool Company, Fisher Building, Chicago, or 95 Liberty street, New York.

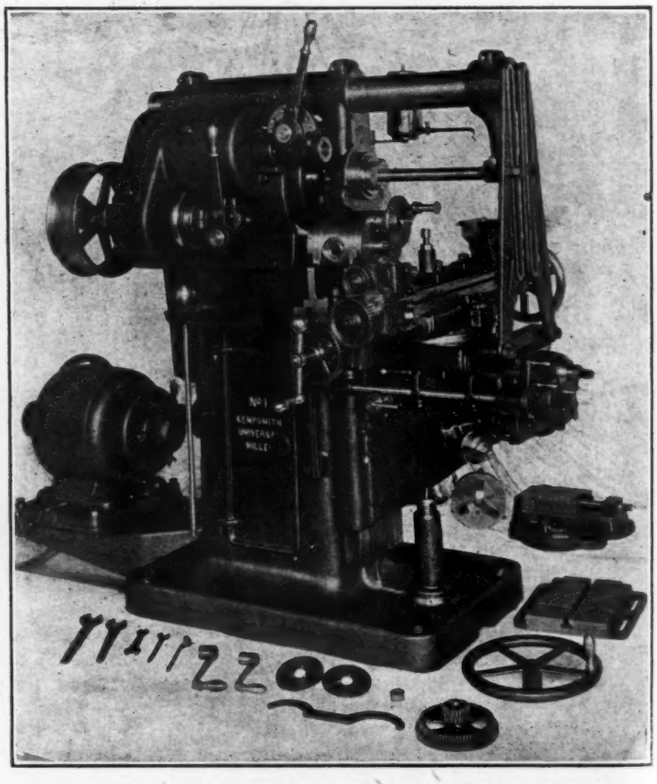


A NEW FRANKLIN AIR COMPRESSOR.

MOTOR DRIVEN MILLING MACHINE.

The photograph illustrates a motor drive applied to an improved Kempsmith universal milling machine. A 1½-h.p., back gear type, constant speed Browning motor, made by the Northwestern Manufacturing Company of Milwaukee, is mounted on an extension which is rigidly bolted to the base of the machine. The back gear shaft of the motor may be connected to the driving shaft of the machine by either a wide belt or a silent chain. The motor application illustrated may be made at any time, but a more compact arrangement may be provided if it is incorporated in the machine while it is being built. Sixteen changes of spindle speed are provided. As these are obtained through ring frictions, the changes can be made while the machine is in motion without in any way interfering with its operation. The levers controlling these speed changes are within easy reach of the operator, who by referring to an index plate conveniently placed can readily determine the combination for the speed desired.

All feeds to the table are positive and automatic. The gear box, which contains a simple and powerful geared feed changing mechanism, is recessed into the column and is thus rigidly supported without any overhanging part. It is driven direct from the spindle by a sprocket chain. Through the levers shown on the gear box 16 changes of feed are available in geometrical progression, the range being selected for greatest efficiency in ordinary milling. An index plate on the front of the gear box shows the combination to obtain any desired feed. The levers for reversing all feeds and for automatically tripping all feeds at any time, are centrally located at the front of the knee, so that all movements of the machine are under the immediate control of the operator without changing his position.



KEMPSMITH UNIVERSAL MILLING MACHINE, MOTOR DRIVEN.

The column, base and bridge for the overhanging arm are cast in one piece with substantial internal ribs, which serve as tie plates for the sides of the column and also form a series of handy shelves. The swiveling table shown in the illustration is easily and firmly clamped at any position by an improved bevel clamping ring. The universal dividing head is simple and compact. The improved construction of the side

center tail stock allows the use of large diameter end milling cutters up to within ⅛ in. of the center. The center can easily be raised for milling tapers. The telescopic elevating screw permits the table to travel to its lowest point without requiring a hole in the floor or foundation. This machine is made by the Kempsmith Manufacturing Company of Milwaukee, Wis.

A NEW GENERATING SET.

In response to the growing demand for a high class generating set at a reasonable price, the B. F. Sturtevant Company, of Boston, Mass., are manufacturing a type illustrated by the accompanying engravings.

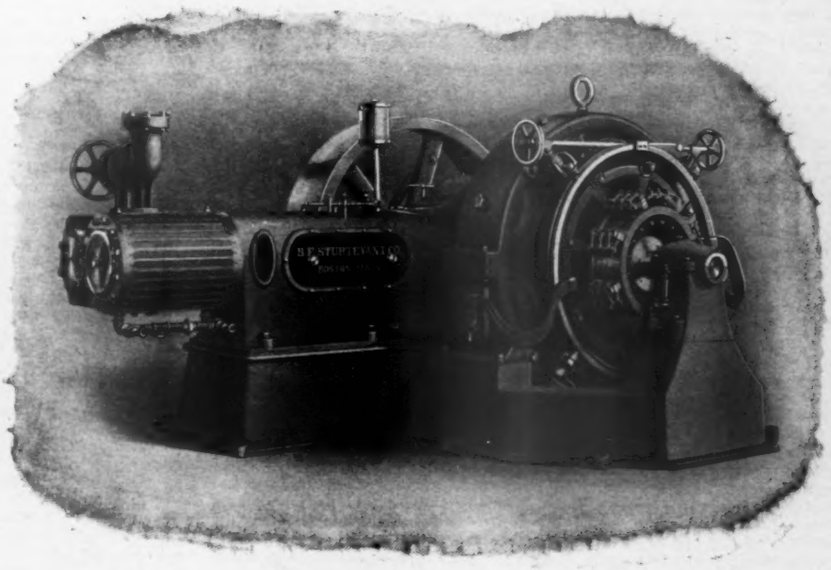
The general design of the engine embodies all the latest improvements to the horizontal type. The reciprocating parts are substantially constructed and counterbalanced with lead load discs. The crank shaft is forged solid in one piece and the discs are shrunk onto it. A special arrangement of the Rites' governor gives a regulation within 1 to 1½ per cent. from full load to no load, and by a modification of the Marshall valve gear an adjustment of the cut-off from zero to 70 deg. is attained. The main bearings, crank pins, valve stem and slides of this engine are well babbitted with the Sturtevant white metal. A recent and important improvement is a water shed partition which prevents water from the piston rod stuffing box from reaching the interior of the engine frame, and the oil on the reciprocating parts from being thrown out into the engine room. The main body of the engine is enclosed on both sides by removable plates, and the crank webs are enclosed by a cast iron hood having two holes with removable covers, one for the purpose of cleaning the crank pin box while it is in motion and the other for removing the box without taking off the large hood. Between the water shed partition and the front end of the cylinder is a hand hole for reaching the stuffing box bolts.

With the gravity or tank system of lubrication, shown in the illustration, an oil tank supplies the pipe leading to the parts to be oiled. At each point where the oil is delivered is a little gauge glass and valve for regulating the flow at that point. A valve just below the tank regulates the entire oiling system. With the pump, or forced lubricating system, a pump is located in the base of the engine and is operated by a crank shaft. Oil is delivered from this pump to the main bearings and from the main bearings through holes in the crank shaft and web to the crank pin. From this point the oil is conducted up through a hole in the connecting rod to the crosshead pin. A separate set of pipes convey the oil from the crosshead guides to the valve stem guides. The pressure of oil in the bearings under this system will vary from 12 to 18 lbs. per sq. in.

The generator of this set is of the eight-pole type, and is capable of carrying momentary overloads of 50 per cent. without any shifting of brushes or flashing of the commutator, and an overload of 25 per cent. for a period of two hours without undue heating. After a continuous run of ten hours at full load, the increase in temperature above that of the surrounding air never exceeds 40 deg. C. upon the armature and field coils, and 45 deg. C. upon the commutator. The average temperature rise is about 33 to 35 deg. C. Before being shipped, the generator is given a breakdown test of 1,500 volts, alternating for sixty seconds between the conductors and the frame of the machine, to test the insulation.

The magnet frame is the very best grade of cast iron, split horizontally. The pole pieces are of wrought iron, with cast iron shoes or horns, and are secured to the magnet frame by through bolts. Any of the pole pieces may thus be removed to repair the field coils. The latter are wound up in two sections, with an air space between the shunt and series coils. The shunt winding is of double cotton covered magnet wire, thoroughly insulated, and so treated as to be practically waterproof. The series winding is of solid copper bars, insulated in the same manner as the shunt coil. The armature is of the ironclad, form wound, ventilated drum type, having a core built up of charcoal iron plates, which plates, after being thoroughly japanned, are mounted upon a cast iron spider and securely held in position by end flanges. No bolts pass through the armature laminations. The armature spider has an extension upon which is mounted the commutator, making the armature and commutator one unit. The armature conductors are solid copper bars, without joints except at the commutator end. When these bars are formed they are insulated by material not perceptibly affected by heat or ordinary atmospheric moisture.

In the construction of the commutator, only drop-forged or drawn segments are used, these being secured in cast iron shell of spider construction, and clamped in place with a steel ring. No cast segments of any nature whatever are used. The segments are insulated with the best quality of carefully selected mica of a degree of hardness to allow the mica and segment to wear uniformly, obviating trouble from high mica. The end insulation consists of micanite rings, and the whole commutator is assembled while hot, under great pressure. Carbon brushes only are used, the commutator being so proportioned and the brushes of such size as to allow at least one square inch of brush area to every 30 amperes carried. These brushes are carried in holders of most approved construction, each mounted upon a self-contained brush rigging, so arranged that the entire set of brushes may be rotated completely around the commutator. Hand wheels are furnished for adjusting the brushes in position, these hand wheels being so located that the brushes may be adjusted from either side of the generator.



A NEW GENERATING SET.

SECOND TRACK ON SIBERIAN RAILWAY.—A recent report by Prince Hilkoff, minister of ways and communications in Russia, has led to the decision to lay a second track on the Siberian Railway to Lake Baikal. The Baikal Ring Railway and the Manchurian Railway are also to be double tracked, the total cost being estimated at 200,000,000 roubles, and the estimated time required two years.

AMERICAN RAILWAY APPLIANCE EXHIBITION.

The status of this enterprise, which is so important to the railway supply interests of this country, is admirably set forth in the following appeal by the general committee and the rules and regulations which have been established in connection with the exhibition:

APPEAL BY THE GENERAL COMMITTEE OF ARRANGEMENTS TO ALL CONCERNED.

GENTLEMEN:

The Congress of the United States, with the approval of the President, has signally honored the American manufacturers of railway appliances by the passage of an act permitting an exhibition of the products of their factories to be made on a part of the monument grounds in Washington, D. C., in connection with the meeting of the International Railway Congress, to continue from May 3rd to 14th, inclusive, 1905.

This gracious and generous compliment by the Federal authorities, which places at our disposal a central, convenient and conspicuous site for our exhibition, offers a supreme opportunity for the exploitation and exaltation of our craft. To improve it, is a duty; to neglect it, would be un-American.

The occasion will be unique in the annals of our industry. For a period of twelve days several hundred railway officials of high and important rank, representing many foreign countries, together with more hundreds of American railway officials of similar rank, will be gathered in Washington for the sole purpose of discussing railway problems.

In connection with this distinguished assemblage what could be more appropriate or important than an exhibition which shall show the fertility of resource, inventive genius, energy, enterprise and economic achievement of those who study with assiduity and with the zeal born of commercial ambition the requirements of railway operations.

The members of the American Section of the International Railway Congress are most anxious that the first meeting in America of the congress shall be a crowning success. As an adjunct powerfully conducive to such a success, the proposed American Railway Appliance Exhibition has their cordial approval.

Your committee appeals to the patriotic impulses and commercial acumen of our fraternity to make the proposed exhibition such a demonstration as shall command the interested attention of all railway officials, and cause to be known to the world what the American manufacturer has accomplished for the railways in solving some of their vexatious and pressing engineering and operating problems.

Your especial attention is called to the fact that the delegates to the International Railway Congress are being chosen from the executive, operating, mechanical and maintenance of way officials. All departments with which the supply men have dealings will be represented.

While the exhibition will offer exceptional advantages to those who seek export trade, it cannot be too forcibly stated that those who manufacture exclusively for American trade will have an opportunity to gain the attention of a larger number of American railway officials than has heretofore been enjoyed at any similar exhibition.

The director of exhibits has been authorized by the committee to invite applications for membership and for exhibit space under certain rules and regulations prescribed by the committee, which are fully set forth in the director's circular, and it is our earnest hope that the responses thereto will be prompt and in such numbers as shall show enthusiastic concert of action, and that a happy issue of our undertaking shall be quickly assured.

Again, you are reminded that the funds subscribed by you will be disbursed with due heed to proper economy, in keeping with such a great and dignified enterprise, and that no member of the committee or any officer thereof is to receive any monetary compensation for his services. It will be compensation enough for your servants on the committee if their efforts shall redound to the general welfare of the industry they seek to serve.

The fees for membership and for exhibit spaces have been fixed by the committee at figures to insure financial solvency beyond a peradventure. A deficit would be disgraceful, and must not occur; a surplus can readily be returned pro rata to those contributing, and would be so distributed.

Finally, the appeal is made for exhibits—fine ones, impressive ones. Anyhow, whether you exhibit or not, you are urged to enroll as members, as upon the fund raised from membership fees the proper and adequate administration of the exhibition and the entertainment of the visitors thereto depends.

Now, gentlemen, the preliminary arrangements and our appeal for co-operation having been made, the fate of the exhibition—its success or failure—rests with you.

Fraternally yours,

H. P. Bope, vice-president Carnegie Steel Co.; L. F. Braine, general manager Continuous Rail Joint Co.; A. E. Brown, vice-president Brown Hoisting Machinery Co.; J. B. Brady, vice-president Standard Steel Car Co.; O. H. Cutler, president American Brake Shoe & Foundry Co.; C. A. Coffin, president General Electric Co.; F. H. Eaton, president American Car & Foundry Co.; H. Elliott, Jr., vice-president Elliott Frog & Switch Co.; William Goldie, Sr., William Goldie, Jr. & Co.; F. N. Hoffstot, president Pressed Steel Car Co.; H. S. Hawley, president Railroad Supply Co.; A. B. Jenkins, Jenkins Bros.; Alba B. Johnson, Baldwin Locomotive Works; B. F. Jones, Jones & Laughlin Steel Co.; A. M. Kittredge, vice-president Barney & Smith Car Co.; W. V. Kelley, president Simplex Railway Appliance Co.; Geo. J. Kobusch, president St. Louis Car Co.; E. B. Leigh, vice-president Chicago Railway Equipment Co.; Wm. Lodge, president Lodge & Shipley Machine Tool Co.; General Charles Miller, president Galena-Signal Oil Co.; Charles A. Moore, Manning, Maxwell & Moore; Gov. Franklin Murphy, president Murphy Varnish Co.; D. C. Noble, president Pittsburg Spring & Steel Co.; Hon. H. Kirke Porter, H. K. Porter Co.; A. J. Pitkin, president American Locomotive Co.; Alfred A. Pope, president National Malleable Castings Co.; H. S. Paul, president Verona Tool Works; George A. Post, president Standard Coupler Co.; C. W. Sherburne, president Star Brass Mfg. Co.; C. A. Starbuck, president New York Air Brake Co.; W. W. Salmon, president General Railway Signal Co.; H. A. Sherwin, president Sherwin-Williams Co.; Albert Waycott, president Damascus Brake Beam Co.; H. H. Westinghouse, vice-president Westinghouse Air Brake Co.; W. W. Willits, vice-president Adams & Westlake Co.; J. Alexander Brown, secretary and director of exhibits—General Committee of Arrangements.

January 28, 1905.

FROM THE CIRCULAR OF THE SECRETARY.

Space will be assigned in the order of checks received by Mr. Charles A. Moore, treasurer. Access to the grounds for the erection of individual booths may be had on and after March 20. The exhibition building to be erected by the committee will be ready April 15. All communications concerning membership and space should be addressed to J. Alexander Brown, secretary and director of exhibits, 160 Broadway, New York.

RULES AND REGULATIONS.

Established for the guidance and the government of members and exhibitors in connection with American Railway Appliance Exhibition.

1st. All manufacturers of and dealers in American railway appliances, material and supplies are entitled to membership in the exhibition, upon the payment of a membership fee of $50. Those who are enrolled as members, and only those, shall be entitled to occupy space as exhibitors, but membership is not confined to those who propose to make exhibits.

2nd. Members shall be entitled to attend and participate in all ceremonies, functions and entertainments that may be arranged by the committee; to have issued to them a certificate of membership; to have their names printed in an official pamphlet to be published by the committee in connection with the exhibition stating the nature of their business and where located, and to receive such badges as may be designed by the committee to be worn by members during the continuance of the exhibition.

3rd. The committee will erect a large building for the housing of the smaller and lighter exhibits, similar to those displayed on the verandas during the mechanical conventions held annually in June. Spaces therein will be 10 feet in depth and 5 feet in width or the multiples thereof. A charge of fifty cents per square foot will be made for space occupied in this building.

4th. Exhibits to be operated by power, excessive in weight or requiring large space, necessarily have to be installed outside of the exhibition building erected by the committee, and the booths, pavilions or other structures in connection therewith will be erected by the exhibitors at their own expense. A charge of ten cents per square foot will be made for ground so occupied.

5th. A temporary track will be laid on B street, fronting the exhibition grounds, for the display of cars of the various types. The charge to be made per car will be announced at an early day.

6th. The ground to be occupied for the exhibition is a part of the government reservation in Washington, and its use is subject to restrictions prescribed by the secretary of war; therefore, it is to be expressly understood by the exhibitors that no excavations for foundations can be made, but all exhibit structures must rest upon foundations that may be laid upon the surface of the ground.

7th. Before any application for exhibit space shall be considered and space assigned, the applicant shall have first made application for membership, accompanied by check for fifty dollars, the membership fee, and the application for space shall be accompanied by check for the amount of space desired at the rate per square foot as prescribed in rules 3 and 4 hereof.

8th. It is to be expressly understood by and between the committee of arrangements for the exhibition and the exhibitors thereat that the said committee shall not be held liable under any circumstances for any loss or damage by fire, flood or other casualty, or by theft. The committee will arrange for such safeguarding of the exhibits as will, in their opinion, prove adequate during the continuance of the exhibition, but as the exhibition is not an incorporated body and the service of the committee and its officials is purely a voluntary and gratuitous one, in the interest of our great industry, its members, of course, will not be expected to assume any personal liabilities in connection therewith so far as exhibitors are concerned.

9th. According to the provisions of the joint resolution adopted by Congress, all structures erected upon the grounds for the purposes of the exhibition, must be approved by the officer in charge of public buildings and grounds before erection thereof can be begun, hence it will be necessary for exhibitors proposing to erect their own exhibit structures to submit plans therefor at the earliest possible date to the director of exhibits for such approval. As a general suggestion in regard thereto, such booths or exhibit structures should be of tasteful design, about 12 feet in height from the platform at the eaves, if covered, and of sufficient slope from the ridge pole to permit of proper drainage.

10th. The director of exhibits shall also approve of the size, design and location of all signs to be used for display purposes.

11th. It is also to be expressly understood by exhibitors erecting their own exhibit structures that such structures and the exhibits therein shall be entirely removed from the grounds prior to May 25th, 1905, as that is the date fixed by the Act of Congress when the right to use said grounds for exhibition purposes will expire.

12th. Steam and electric power will be placed at a central point, exhibitors to make their own connections and pay for the power used.

PERSONALS.

Mr. R. R. Young has been appointed master mechanic of the Atlantic Coast Line at Waycross, Ga., to succeed W. H. Dyer, resigned.

Mr. D. J. Timlin has been appointed master mechanic of the Rio Grande, Sierra Madre & Pacific, with headquarters at El Paso, Tex.

Mr. William Miller has been appointed assistant superintendent of motive power of the Denver & Rio Grande, with headquarters at Denver, Col.

Mr. William Bowden has been appointed master mechanic of the Terminal Railroad Association of St. Louis to succeed Mr. William Miller, resigned.

Mr. David Anderson has been appointed superintendent of equipment of the Chicago, Indiana & Eastern Railway, with headquarters at Muncie, Ind.

Mr. F. A. Deckert has been appointed master mechanic of the Riverside shops of the Louisville & Nashville Railroad, with headquarters at Knoxville, Tenn.

Mr. George W. Cooper has been appointed master mechanic of the Mexican Central at Monterey, Mex., succeeding Mr. T. H. Ogden, transferred.

Mr. S. A. Chamberlain, general foreman of shops of the Pere Marquette Railway, has been transferred from Ionia to Detroit, Mich.

Mr. W. C. Smith has been appointed master mechanic of the Missouri Pacific, with headquarters at Fort Scott, Kansas, to succeed Mr. W. L. Kellog, resigned.

Mr. J. B. Phillips, machine shop foreman of the San Bernardino shops of the Santa Fe, has been appointed general foreman of the locomotive shops, to succeed Mr. W. L. Essex, resigned.

Mr. J. F. Sheahan has been appointed master mechanic of the Southern Railway at Spencer, N. C., being transferred from Columbia, S. C., to succeed Mr. S. R. Richardson, resigned.

Mr. W. L. Kellog has been appointed master mechanic of the Pere Marquette, with headquarters at Grand Rapids, Mich., to succeed Mr. W. K. Christie, who has been transferred to Saginaw, Mich., as assistant master mechanic.

Mr. R. A. Billingham has been appointed superintendent of motive power of the Pittsburg, Shawmut & Northern Railroad, with headquarters at St. Marys, Pa. He was formerly general master mechanic, which position has been abolished.

Mr. F. A. Delano, general manager of the Chicago, Burlington & Quincy, has resigned. He has been in the service of this road for 20 years, beginning as apprentice at the Aurora shops and rising through both the operating and motive power departments.

James S. Toppan died in Chicago, January 8, at the age of 66 years. He was for a number of years Western manager of the Galena Oil Company, and through his efforts their large business in the West was built up. After leaving that company he represented a number of concerns in Chicago, and was one of the best-known railway supply men.

Mr. W. H. Baldwin, Jr., president of the Long Island Railroad, died January 3d and is mourned by many inside and outside of railroad circles. He was 41 years old and his remarkable career showed his phenomenal ability. He is succeeded by Mr. William F. Potter, formerly vice president of the road.

Mr. J. W. Marden has been appointed assistant master car builder of the Boston & Maine Railroad, with headquarters at Boston, Mass. Mr. Marden was heretofore general foreman of the car department.

Franklin David Child, formerly superintendent of the Hinkley Locomotive Works, of Boston, died at the Hotel St. Andrew, New York, on the evening of January 12. He was born in Boston, in 1843, and was thus sixty-two years old at the time of his death. Quite early in life he manifested a decided taste and aptitude for mechanics, and during his youth his leisure time was much occupied in the construction of mechanical contrivances of various kinds, which are so attractive to boys of that turn of mind. During the Civil War he enlisted in one of the nine-months' regiments which were organized in Massachusetts, and did service for that length of time in North Carolina. Soon after his term of enlistment expired, he entered the service of the Hinkley & Williams Works, which succeeded the old firm of Hinkley & Drury. He was at first draftsman there, and afterwards became the superintendent and manager. In that specialty he was a person of remarkable ability and ingenuity. This was combined with excellent judgment of the practicability of any form of mechanism, a combination of traits which is somewhat rare. After the death of Mr. Hinkley and Mr. Williams, the name of the company was changed to the Hinkley Locomotive Works, with Mr. Child as manager, and while the business was continued he transformed the locomotives which were built there from a somewhat antiquated pattern to a new one, which showed in marked degree the ability of the designer. After the failure of that company he was for a time employed as superintendent in the Providence Locomotive Works, and later in similar works in Kingston, Canada. During the past five or six years he was night superintendent of the great Baldwin Locomotive Works, in Philadelphia, and it was in that service that he contracted his last illness, which was a complication of diseases, and was quite suddenly fatal. He was of a rather retiring disposition, which, perhaps, stood in the way of his advancement, but was a delightful companion to those who knew him well; the soul of honor, a warm friend of those with whom he was in sympathy, and as an engineer, in his own specialty, he had few, if any, superiors. He left a wife and two daughters, to whom and his old and near friends his death is an irreparable loss.

NORTHERN PACIFIC OFFICIAL APPOINTMENTS.—A number of appointments in the mechanical department of the Northern Pacific Railway are summed up as follows:

Mr. A. W. Wheatley, general master mechanic, St. Paul, Minn.

Mr. W. S. Clarkson, general master mechanic, Livingston, Mont.

Mr. William Moir, general master mechanic, Tacoma, Wash.

Mr. F. B. Childs, master mechanic, Spokane, Wash.

Mr. R. M. Crosby, shop superintendent, South Tacoma, Wash.

Mr. Thomas Jackson, shop superintendent, Livingston, Mont.

Mr. R. P. Blake, assistant shop superintendent, Brainerd, Minn.

Mr. J. E. O'Brien, assistant shop superintendent, South Tacoma, Wash.

Mr. C. S. Larrison, master mechanic, Dakota Division, Jamestown.

Mr. S. H. Draper, general air brake inspector, St. Paul, Minn.

Mr. Mark Purcell, assistant air brake inspector, St. Paul, Minn.

Mr. J. J. Davey, general boiler inspector, St. Paul, Minn.

Mr. G. F. Egbers, road foreman of engines, Spokane, Wash.

Mr. C. F. De Grat, road foreman of engines, Livingston, Mont.

Mr. L. A. Larsen, chief clerk, motive power department, St. Paul, Minn.

Mr. W. L. Kinsell, chief draftsman, St. Paul, Minn.

The shop and road responsibilities are separately provided for and much may be expected from such an organization.

Mr. J. P. Young has been appointed master car builder of the Missouri Pacific Railway, with headquarters at St. Louis, Mo.

Mr. John Fifer has been appointed master mechanic of the Chicago, Burlington & Quincy Railway, with headquarters at Des Moines, Ia.

William Sellers, president of William Sellers & Company of Philadelphia, died January 24 after a surgical operation. He was born in 1824 in Pennsylvania, and spent his entire business career in the manufacture of steel and machine tools, being the founder of the company which bears his name. In 1873 he was president of the Midvale Steel Company.

BOOKS.

ENGINEERS OF AMERICA.—A directory and biography of the engineers of America is in preparation by Mr. Ernest C. Brown, publisher of the Progressive Age, 220 Broadway, New York. The proposed volume will present brief biographies of about 3,000 engineers, and it is the intention to record only the names and life work of men who have become prominent by their accomplishments in engineering. This volume will soon come from the press. The work promises to be unique and valuable to the engineering profession.

The Mechanical World Pocket Diary and Year Book for 1905. Published by Emmet & Company, publishers of the *Mechanical World*, New Bridge street, Manchester, England.

This is the eighteenth annual edition of this convenient little book. Its size is increased this year by the addition of a table of trigonometrical ratios and formulæ and other tables of squares, cubes and fourth powers of fractions, a collection of powers, roots and reciprocals of factors often desired by engineers. The matter on ball bearings has been revised and other sections enlarged.

Business Short-Cuts, in Accounting, Bookkeeping, Correspondence and Management. Published by The Bookkeeper Publishing Company, 61 West Fort street, Detroit, Mich. Price, $1.00.

This little book has many good points and contains valuable suggestions for chief clerks and bookkeepers of railroads, as well as other lines of business. The various chapters are taken from different issues of the *Bookkeeper and Business Men's Magazine* and are thrown together without any attempt at classification. The book is worth the price for its suggestions concerning card indexing alone, if it had no other good points.

Untechnical Addresses on Technical Subjects. By James Douglas, LL.D. Published by John Wiley & Sons, 143 East 14th street, New York, 1904. Price $1.00.

This little book contains three interesting addresses on the following subjects: Characteristics and Conditions of the Technical Progress of the Nineteenth Century, Development of American Mining and Metallurgy and the Equipment of a Training School, also Wastes in Mining and Metallurgy. The subjects are treated in a popular style, being in phases of progress lying within the zone of sociology. The author urges the importance of free interchange of experience in a true professional spirit and argues forcibly against the wasteful effects of secrecy. He outlines the wonderful progress of the past century, which is a result of a spirit of originality and comments favorably upon the independence of American manufacturers in introducing improvements of all kinds. The book wil specially interest those who are concerned in metallurgical manufacturing.

ILLUSTRATED POINTS FOR MEN ON THE HEAD END. By W. G. Wallace. Illustrated and published by the World Railway Publishing Company, 79 Dearborn St., Chicago, Ill. Price $1.00.

This little book contains a large amount of information for locomotive engineers and firemen, condensed in a very small space. The author is superintendent of motive power of the Duluth, Missabe & Northern Railway and from the appearance of the book it is believed to have been gotten up for distribution among his subordinates, and afterwards published for wider distribution. It does not cover enough of the features of locomotive operation to be a complete work, but gives valuable suggestions with reference to such subjects as the arrangement of locomotive front ends in order to secure good steaming qualities; water level is discussed and its relation to operation. Valve gear receives special attention; also adjustment and lubrication. The latter portion of the book contains rules and data issued by the Baldwin Locomotive Works for figuring tractive power.

Fowler's Electrical Engineer's Year Book, 1905. Published by the Scientific Publishing Company, Manchester, England. Price in England, 1 shilling, sixpence.

This very valuable handbook has been brought up to date and considerable new material has been added to the various sections.

Dimensions of Pipe, Fittings and Valves. By W. D. Browning. 82 pages. Published by The Draftsman, 204 Superior street, Cleveland, Ohio, 1904. Price 50 cents.

This book was compiled to aid the draftsman, architect and engineer and contains over 50 tables of dimension, nearly all of which are from actual measurement, although some are taken from catalogues. In addition it contains some useful information on steam heating. The book has been very carelessly edited and the inaccurateness of the text lead one to mistrust the tables. The publishers should issue a revised edition, as this information if correct, would prove of much value to engineers.

National Railroad Master Blacksmiths' Association Proceedings of the 12th Annual Convention. Edited by the Secretary, A. L. Woodworth, Lima, Ohio.

This volume contains reports and discussions of the Indianapolis meeting held last August. The most important subjects were spring making, tool steel forging and tempering, selection and testing of material, material for forgings, the ideal blacksmith shop (a paper by Mr. McCaslin), the making and repairing of locomotive frames, alumino-thermics, oil furnaces, formers for bulldozers, frame welding, and other important matters relating to the blacksmith work on railroads. This association is doing excellent work which entitles it to more attention from railroad officials than it has thus far received.

Handbook of Builders' Hardware. A Handbook for Architects. By Henry R. Towne, president of the Yale & Towne Manufacturing Company. 1,072 pages, 4 x 6½ ins. Published by John Wiley & Sons, 43 East 19th street, New York. Price $3.

This book is unique. It is not an advertisement or catalogue, but a volume on builders' hardware as related to the architect and architecture. It is profusely illustrated; it contains a historical review and deals with many designs and forms of fine hardware. A series of articles on schools of ornament by Mr. W. W. Kent are illustrated with pictures from many sources which will be valuable to the architect. Scales of prices, lists of hardware and other features of service to the architect are included. The author frequently refers to the product of his company in this technical treatise on his subject.

Mechanical Railway Signaling. By H. Raynar Wilson, late signal engineer of the Lancashire & Yorkshire and the Mildand railways (England). Published by the *Railway Engineer*, 3 Ludgate Circus Buildings, London, E. C., England. 193 pages (9 by 12 ins.), illustrated. Price $5.

This is the second edition of this admirable work; the first appeared in May, 1900. Its chapters are: Introduction, single lines, signal boxes, signals, signal and point connections, locking frames, signal plans and locking lists, level crossing gates, large signal plants, the signal department, Board of Trade requirements and standard specifications for signaling works. It is devoted to English practice, and there is no work on signaling as good as this. The author really takes the reader into the heart of signal practice and presents working drawings of the elements employed and the buildings used, and goes into detail as no other signal authority has ever done. No American signal engineer can afford to be without this book as it is a record of practice in a country where railroad signaling is appreciated and is reduced to an exact science.

Elements of Mechanism. By Peter Schwamb, Professor of Machine Design, and A. L. Merrill, Associate Professor of Mechanism, Massachusetts Institute of Technology. 264 pages, 6 x 9 ins., illustrated. Published by John Wiley & Sons, 43 East 19th street, New York. Price $3.

This excellent book is the result of a demand outside the Massachusetts Institute of Technology for the notes used in the mechanism course so successfully by Professor Schwamb. The authors do not claim originality, but the merit of the book is that it renders it possible to cover a great deal of ground in a short time. In clearness it surpasses all other books on this subject with which the reviewer is familiar. The book opens with the elements of motion and velocity. Pairs of elements, rolling cylinders, cones and lobed wheels are followed by belts, levers, links, parallel motions, wheels in trains, aggregate combinations and gearing. The book is intended for use in schools, but is well adapted to the independent student.

LETTERS FROM AN OLD RAILWAY OFFICIAL TO HIS SON, A DIVISION SUPERINTENDENT.—By Charles De Lano Hine. Chicago: The Railway Age, 5 by 7½ ins., 179 pages. Price, $1.50.

In these letters to his "son" the author reaches the difficulties of many men in all branches of railroad service. The plan would be audacious in the hands of any but a master; but Major Hine is a master. This strong book will surely exert an influence over many men in railroad service. It amuses while it instructs and the author's style is exactly suited to his object. It is breezy, bright, virile and humorous. Major Hine is on the staff of the second vice-president of the Burlington system. He knows his subject and he understands men. The book will be read with profit by the president and the office boy. It will tend to turn the wheels out of the ruts. In the letters all branches of the operating department receive critical attention and many opportunities for improvement are pointed out with a fearless directness and yet in a pleasing way. Railroad language is used with telling effect. Not only operating, but other officers and subordinates in all departments, will receive inspiration from this book.

Tests Upon Reinforced Concrete Beams. By Arthur N. Talbot. Bulletin No. 1 of the University of Illinois Engineering Experiment Station.

The tests described at length in this bulletin furnish a valuable addition to our knowledge of the action of reinforced concrete beams, and the thanks of the engineering profession are due to Professor Talbot for the thoroughness with which the experiments were made and the results presented. Especially valuable are the data given upon the location of the neutral axis under varying loads since all formulæ for the strength of such beams must be based upon its position and although other careful experimnts to determine this have been made, so far as we are aware none have yet been published in such complete detail. One of the interesting points to be noted in connection with these tests is that all the beams failed at the center through bending rather than at the ends through tension at 45 deg. to the neutral axis. These results do not agree with certain other experiments upon such beams, notably those made by Professor Lanza at the Massachusetts Institute of Technology and described in Vol. L of the Transactions of the American Society of Civil Engineers. The reason for this difference in the method of failure might well be studied by future experimenters.

CALENDARS FOR 1905.—Calendars have been received from well known concerns as follows: The Standard Tool Company have distributed a calendar on the back of which is a very convenient collection of tables, of special value to users of machine tools in connection with twist drills, milling cutters and other tools. This gives sizes of twist drills, speed for various materials, size of sockets, standard threads and cutting speeds for milling machines, shapers and lathes. This calendar will be in special demand and readers desiring them would do well to make their request for copies early.

The Falls Hollow Stay Bolt Company, Cuyahoga Falls, Ohio, have issued one bearing a well executed picture which will be specially appreciated by fishermen who may have mistaken movements of the rod, due to the activity of a small dog, for the vigorous bite which is so dear to the heart of an ardent angler.

The Kennicott Water Softener Company have distributed an exceedingly handsome reproduction of a picture entitled "Marcelle" by Angello Asti. It is a beautiful work of art.

The Triumph Electric Company's calendar is very attractive and presents the same work of art as that of the Kennicott Water Softener Company, with a difference in the coloring.

The Cleveland Pneumatic Tool Company of Cleveland, Ohio, have sent out two exceedingly handsome calendars in colors which are unique in this branch of advertising.

Another by the Universal Safety Tread Company, 45 Broadway, New York, illustrates safety treads as applied to locomotive steps.

SUBJECTS FOR THE TRAVELING ENGINEERS' ASSOCAITION.—At the next meeting of the Traveling Engineers' Association the following subjects will be discussed: 1. Is a third man necessary on large locomotives? 2. Grease as a lubricant for all locomotive bearings. 3. Devices and arrangement of engines and tenders to lighten the work of the engineer and fireman. 4. Care and arrangement of bell ringers, air sanders and other devices operated by compressed air.

Papers will be received on electric motors, injectors, lubricants, mechanical stokers and piston valves.

Wanted—Complete volumes of this journal, unbound, for the years 1896, 1897, 1898 and 1899. Address the Editor, AMERICAN ENGINEER, 140 Nassau street, New York.

NEW CATALOGUES.

IN WRITING FOR THESE CATALOGUES PLEASE MENTION THIS PAPER.

WOODWORKING MACHINERY.—Catalogue No. 21 from the Frank Machinery Company of Buffalo, N. Y.

CRANES.—Illustrated catalogue of the various cranes designed and constructed by William Sellers & Company, Philadelphia, Pa.

PIPE THREADING AND CUTTING OFF MACHINES.—Circulars from the Stoever Foundry & Manufacturing Company, Myerstown, Pa.

DE LAVAL STEAM TURBINE ALTERNATORS.—Bulletin No. 3 from the De Laval Steam Turbine Company, Trenton, N. J.

AIR COMPRESSORS.—Catalogue No. 36 from the Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York.

DYNAMOS AND MOTORS.—Bulletins from the Commercial Electric Company, Indianapolis, Ind.

LOCOMOTIVE COALING CRANES.—Catalogue from the Brown Hoisting Machinery Company, Cleveland, Ohio.

DIRECT CURRENT MOTORS.—Bulletin No. 1 from the Burke Electric Company, Erie, Pa., describing their AB type motors.

PULLEYS.—Circular describing the pressed steel pulleys made by the Phillip's Pressed Steel Pulley Works, Philadelphia, Pa.

POWER TRANSMISSION APPLIANCES.—Catalogue No. 18 from the Case Manufacturing Company, Columbus, Ohio.

FRICTION CLUTCHES.—Booklet C from the Carlyle Johnson Machine Company, Hartford, Conn.

INSPIRATORS.—Pocket edition of the large catalogue issued by the Hancock Inspirator Company, 85 Liberty street, New York.

MOTORS AND GENERATORS.—Bulletin 3055 from the Western Electric Company, 463 West street, New York, describing their encased, protected and semi-encased motors and generators.

INTER-POLE VARIABLE SPEED MOTOR.—Bulletins 1, 2 and 3, series "B," from the Electro Dynamic Company, Bayonne, N. J., describing this motor and illustrating applications to various machine tools.

MOTOR DRIVEN FRICTION AND BENCH DRILLS.—Bulletin No. 3061 from the Emerson Electric Manufacturing Company, St. Louis, Mo.

"RING TURRET" LATHE.—Catalogue from the Walter H. Foster Company, 126 Liberty street, New York, describing this interesting lathe.

ARC LAMPS.—Bulletins 7030, 7035 and 7040, issued by the Western Electric Company, New York, describing arc lamps for direct and alternating current circuits.

UNIVERSAL CUTTER AND TOOL GRINDER.—Circular from the Oesterlein Machine Company, Cincinnati, Ohio, describing their No. 2 machine.

INJECTORS.—A pocket edition of the catalogue describing the Metropolitan injectors made by the Hayden & Derby Manufacturing Company, 85 Liberty street, New York.

HYATT FLEXIBLE ROLLER BEARINGS.—Bulletin No. 116 from the Hyatt Roller Bearing Company, Harrison N. J., presenting a report on power saved by substituting their bearings in place of ring oiling babbitted bearings.

MULTI-SPEED MOTORS.—Bulletin No. 45, issued by the Northern Electrical Manufacturing Company of Madison, Wis., describes their new multi-speed motor, explains the ease with which it can be applied to old belt-driven machine tools, and considers the advantages to be gained by its use.

OIL SWITCHES AND OIL CIRCUIT BREAKERS.—The Westinghouse Electric & Manufacturing Company of Pittsburg are about to distribute Circular No. 1,096, which describes and illustrates the various types of oil switches and oil circuit breakers made by them. These include high tension oil circuit breakers designed for pressures as high as 60,000 volts.

WESTINGHOUSE DIARY.—A convenient vest pocket diary has been issued by the Westinghouse Electric & Manufacturing Company. In addition to the diary itself and the information usually contained in books of this kind, it has about forty pages of valuable engineering data which will be appreciated by engineers, especially those interested in electric and steam practice. It is the best book of its kind that we have seen.

PRECISION TOOLS.—A handsomely illustrated and printed cloth bound book of 216 pages, with the above title, describes the products of the Pratt & Whitney Company, and is just about to be issued by the Niles-Bement-Pond Company. The first part of this book is devoted to machine tools, which include bench, tool makers, engine and turret lathes; automatic screw machines; shaping, milling, profiling, thread-milling, die-sinking and gear-cutting machines; sensitive and multi-spindle drills; grinding, tube and gun barrel drilling, rifling, centering, cutting-off, roll grooving, tapping, and screw shaving machines; rotary oil pumps and chucks. The second part of the book is devoted to small tools and gauges, which include taps, die-stock sets, milling cutters, metal slitting cutters, reamers, mandrills, taper pins, ratchet drills, punches, punch couplings, standard dies, gauges of all kinds and standard measuring machines.

NOTES.

KENNICOTT WATER SOFTENER COMPANY.—Mr. W. R. Toppan, who has held the position of manager of the railroad department of this company since its organization, has been elected general manager, with headquarters in the Railway Exchange Building, Chicago.

Mr. A. E. Ostrander has been appointed assistant mechanical engineer of the American Car & Foundry Company, in charge of the designing work, at the general offices in New York, which has formerly been done at Berwick, Pa. Mr. Ostrander has been engaged in estimating and special designing, and was formerly employed by the Standard Steel Car Company of Pittsburgh. He will report to Mr. John McE. Ames, mechanical engineer.

CONTINUOUS RAIL JOINTS.—The Illinois Steel Company is about to begin an extension of its works at Joliet, Ill., at a cost of one hundred thousand dollars ($100,000.00) to accommodate the business of the Continuous Rail Joint Company of America. The latter company is a New Jersey corporation with headquarters at Newark, N. J. It has extensive works at Troy, N. Y., but its western business requires a plant nearer the center of that trade and for this reason the arrangements noted above have been made with the Illinois Steel Company.

FARLOW DRAFT GEAR.—This gear will be applied to 1,000 steel hopper coal cars of 50 tons capacity which are being built for the Delaware, Susquehanna & Schuylkill Railroad by the Pressed Steel Car Company. This gear was illustrated in this journal in September, 1904, and a remarkable test, made at Purdue University, was recorded in the December number, page 482. The Farlow Draft Gear Company will remove, February 1, from temporary quarters at 223 North Calvert street to the Continental Trust Building, Baltimore street, Baltimore, Md.

BRODERICK & BASCOM ROPE COMPANY.—This company, whose exhibit at the Louisiana Purchase Exposition has been mentioned in this journal, received at that exposition five highest awards in all. The grand prizes were for wire ropes in Mines and Metallurgy Building, for wire ropes in the Manufacturers' Building and for underground wire rope haulage. This is the only firm of all the exhibitors in the Manufacturers' Building receiving a grand prize for the excellence and superiority of wire rope. The address of this company is 805 North Main Street, St. Louis, Mo.

CINCINNATI PLANER COMPANY.—The Cincinnati Planer Company of Cincinnati, Ohio, have increased their capital stock to $200,000, and elected the following officers: C. H. M. Atkins, president; B. B. Quillen, secretary and treasurer; George Langen, general superintendent. These officers, together with E. N. Atkins and C. M. Quillen, make up the directory. W. H. Burtner, former president of the company, retires on account of poor health. Mr. Atkins, the new president, is also president of the Warner Elevator Company and the Norwood National Bank, and is connected with several other leading concerns of Cincinnati.

MONARCH RAILWAY SUPPLY COMPANY.—This company has been organized to handle railway specialties, with Mr. Harry W. Frost as president and with headquarters at Detroit, Mich. Arrangements have been made with the Pressed Steel Car Company for the sale of their trucks, bolsters, brake beams and steel carlines. In addition to these specialties, the company will go into the manufacturing business. One article of manufacture will be the Daly railway spikes, which will be placed upon the market about March 1. The temporary offices of the company are in the Majestic Building, Detroit, and permanent offices will be located in the Penobscot Building after May 1, 1905.

TURBO-GENERATORS FOR TRACTION WORK.—The Westinghouse Electric and Manufacturing Company has sold to the Syracuse Railroad Construction Company apparatus for the complete equipment of the Rochester, Syracuse & Eastern Railroad. The contracts include 2 1,500-kw. turbo-generator outfits which will generate current at 3,300 volts, 3-phase and 25 cycles. Each turbo-generator will be furnished with a 50-kw. exciter mounted on the turbine shaft. The equipment also includes 2 500-kw. rotary converters and 6 400-kw. rotary converters; 24 transformers, with a total capacity of 6,500 kw., a 13-panel switchboard for the main generating station, and 3 sub-station switchboards of 5 panels each, as well as protective and detail apparatus. Motor equipments included in the contract call for 12 quadruple equipments of Westinghouse 110-h.p. motors, as well as 8 quadruple and 2 double equipments of motors of other sizes.

MANNING, MAXWELL & MOORE.—Mr. Charles A. Moore announces that he has purchased the entire interest of Mr. Henry S. Manning in the firm of Manning, Maxwell & Moore, together with his interest in the various manufacturing concerns, viz.: The Ashcroft Manufacturing Company, The Consolidated Safety Valve Company, The Hayden & Derby Manufacturing Company and The Hancock Inspirator Company. There will be no change in the name of the firm and its business will continue to be conducted as in the past. The firm now has branch offices in Chicago, Cleveland, St. Paul, Pittsburgh, Boston and Philadelphia. Various interests have been acquired, so that at present the firm is interested in the manufacture of steam gauges, indicators, pipe fitting tools, safety valves, injectors, ejectors, Hancock inspirators, various kinds of valves and electric traveling cranes. In addition to these the firm handles railway and machinists' tools and supplies, air compressors, pneumatic hoists, riveters, and complete machine shop and foundry equipment. The offices will continue at 85 Liberty St., New York.

ARTHUR M. WAITT.—Mr. Waitt has opened an office in the Whitehall Building, 17 Battery Place, New York, as a consulting engineer and railway specialist. He will devote his efforts in the direction of railroads, having been closely associated with mechanical railroad problems for 25 years. His services are available in a consulting capacity by railway or other companies desiring expert advice in mechanical department matters, or in investigating and developing mechanical devices or patents. His years of experience in the mechanical departments of the Lake Shore and the New York Central railroads have been supplemented by extensive study and personal observation, both in Europe and in the United States, in the application of heavy electric traction as a substitute for steam. This prepares him to act in a consulting capacity for railway companies contemplating the electrification of parts of lines of railways. He is also prepared to act in the selection and purchase of railway supplies for companies desiring an experienced representative in such matters in New York. Mr. Waitt's experience, energy and business capacity will render his services exceedingly valuable to the railroads.

THE FALLS HOLLOW STAY BOLT.—Several thousand feet of double refined charcoal iron hollow bar have been ordered from the Falls Hollow Stay Bolt Company, Cuyahoga Falls, Ohio, by the Baldwin Locomotive Works for use in a number of locomotives which are being built for export to Brazil. These stay bolt manufacturers are receiving orders from many foreign countries. The volume of business with Canadian and Mexican railroads for 1904 was double that of 1903. The increase of business has necessitated a large addition to the plant during the past year, including buildings, heating furnaces and other facilities which have doubled its capacity.

WANTED—POSITION AS SALESMAN.

A gentleman "who can reach the railroad men," steam and electric railroads, and who has a large trade among railroads, car, ship, locomotive and bridge builders, will be open to engagement after February 1st as traveling salesman in any line of goods demanded in those markets; has been specially successful in introducing novelties that reduce the cost of operation; can offer first class references from among his customers as to his abilities and standing among them. Address H. H., care of Editor of AMERICAN ENGINEER.